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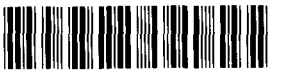

Passive and Active Soil Gas Sampling at the Mixed Waste Landfill, Technical Area III, Sandia National Laboratories/New Mexico

Michael D. McVey, Timothy J. Goering, Jerry L. Peace

Prepared by
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ABSTRACT

The Environmental Restoration Project at Sandia National Laboratories, New Mexico is tasked with assessing and remediating the Mixed Waste Landfill in Technical Area III. The Mixed Waste Landfill is a 2.6 acre, inactive radioactive and mixed waste disposal site. In 1993 and 1994, an extensive passive and active soil gas sampling program was undertaken to identify and quantify volatile organic compounds in the subsurface at the landfill.

Passive soil gas surveys identified levels of PCE, TCE, 1,1,1-TCA, toluene, 1,1,2-trichlorotrifluoroethane, dichloroethyne, and acetone above background. Verification by active soil gas sampling confirmed concentrations of PCE, TCE, 1,1,1-TCA, and 1,1,2-trichloro-1,2,2-trifluoroethane at depths of 10 and 30 feet below ground surface. In addition, dichlorodifluoroethane and trichlorofluoromethane were detected during active soil gas sampling. All of the volatile organic compounds detected during the active soil gas survey were present in the low ppb range.

ACKNOWLEDGMENTS

The authors wish to thank Hans Oldewage and Gordon Coulter of SNL,NM Department 7714, Radiation Protection Operations; Don Schofield of SNL,NM Department 7584, ER Logistics and Integration; and Dale Flores of IT Corporation for their support during this investigation.

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1.0 INTRODUCTION

The Environmental Restoration (ER) Project at Sandia National Laboratories, New Mexico (SNL,NM) is tasked with assessing and remediating the Mixed Waste Landfill (MWL) in Technical Area III (TA-III) under SNL,NM's Resource Conservation and Recovery Act (RCRA) Hazardous and Solid Waste Amendments (HSWA) Part B Operating Permit. The 2.6 acre site was subjected to an extensive soil gas sampling program in 1993 and 1994. Passive and active soil gas technologies were used during the field program to determine the presence, identity, and concentration of volatile organic compounds (VOCs) at 10 and 30 feet below ground surface at the landfill. Soil gas sample locations and sample depths were based on MWL historical records, RFI field data, and previous environmental monitoring results.

1.1 Operable Unit History

The MWL is located approximately 5 miles southeast of Albuquerque International Airport and 4 miles south of SNL,NM TA-I (Figure 1-1). The site covers 2.6 acres in the north-central portion of TA-III (Figure 1-2).

The MWL was operated from March 1959 to 1962 as a disposal site for low-level radioactive and mixed wastes. The MWL was opened originally as the "Area III Radioactive Dump" when the existing low-level radioactive dump in TA-II was closed in March of 1959. In 1967, approximately 270,000 gallons of reactor coolant waste water from the Sandia Engineering Reactor Facility were disposed of in Trench D. Approximately 1 Curie of total radioactivity, mainly short-lived radionuclides, was discharged into the trench with the cooling water. The MWL accepted low-level radioactive and mixed wastes until December 1988, when the landfill was permanently closed. The MWL was the primary disposal site for SNL,NM technical and remote test areas involved in nuclear weapons research and development.

The MWL consists of two distinct disposal areas: the classified area located on the northeast corner of the landfill, occupying 0.6 acres, and the unclassified area comprising the remaining 2.0 acres of the landfill (Figure 1-3). Wastes in the classified area were disposed of in a series of pits. Historical records indicate that the early pits were 3 to 5 feet in diameter and 15 feet deep. Later pits were 10 feet in diameter and 25 feet deep. Wastes in the unclassified area were disposed of in a series of trenches. Records indicate that trenches were 15 to 20 feet wide, 150 to 180 feet long, and 15 to 20 feet deep. Pits were backfilled to within 3 feet of the surface then capped with concrete. Trenches were reportedly backfilled on a quarterly basis and capped with originally excavated soils.

Radioactive wastes disposed of in classified area pits included depleted, natural, and enriched uranium, thorium, barium, enriched lithium, neutron generator tubes and targets,

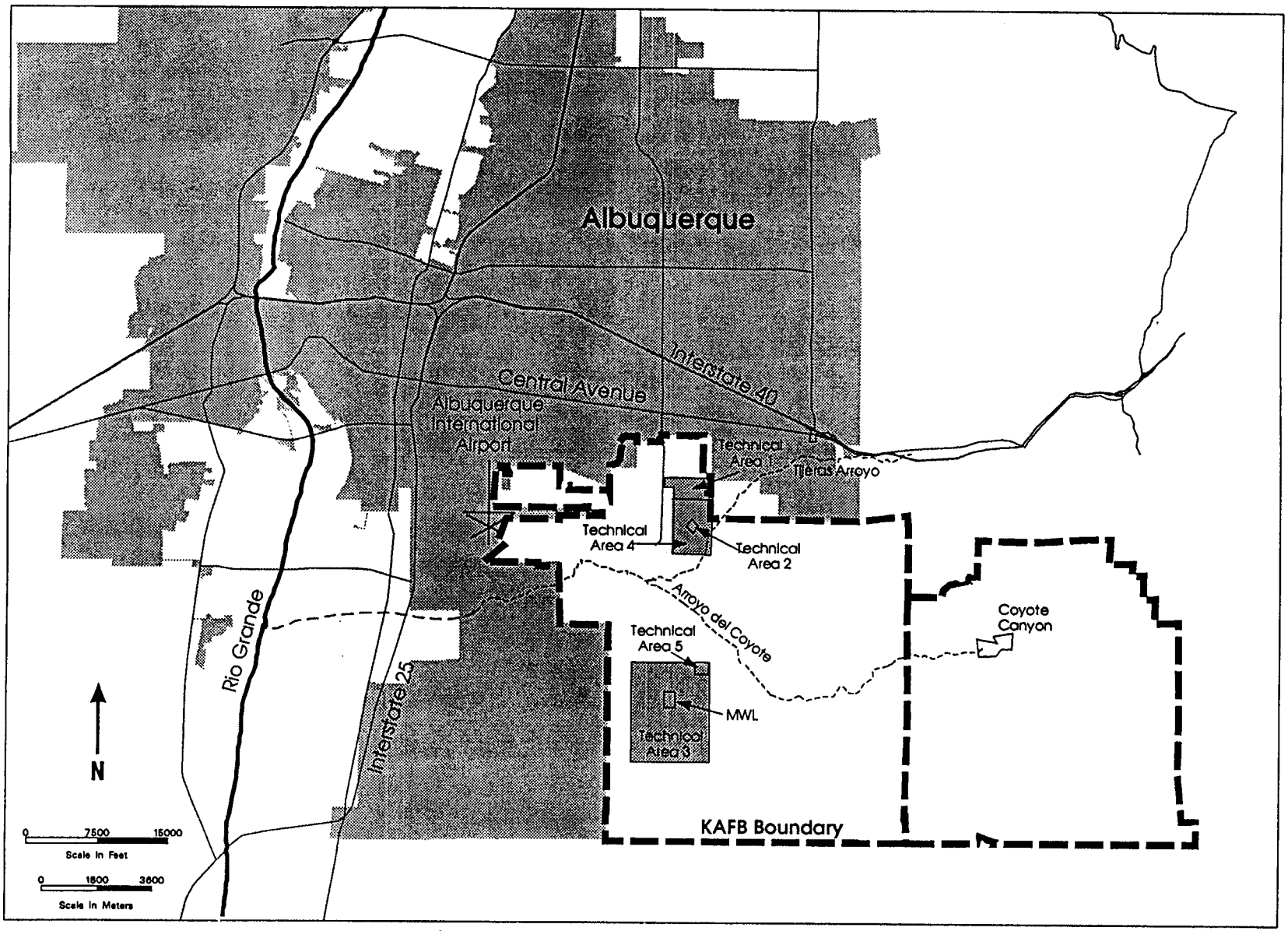

Figure 1-1. Location of KAFB and SNL, NM

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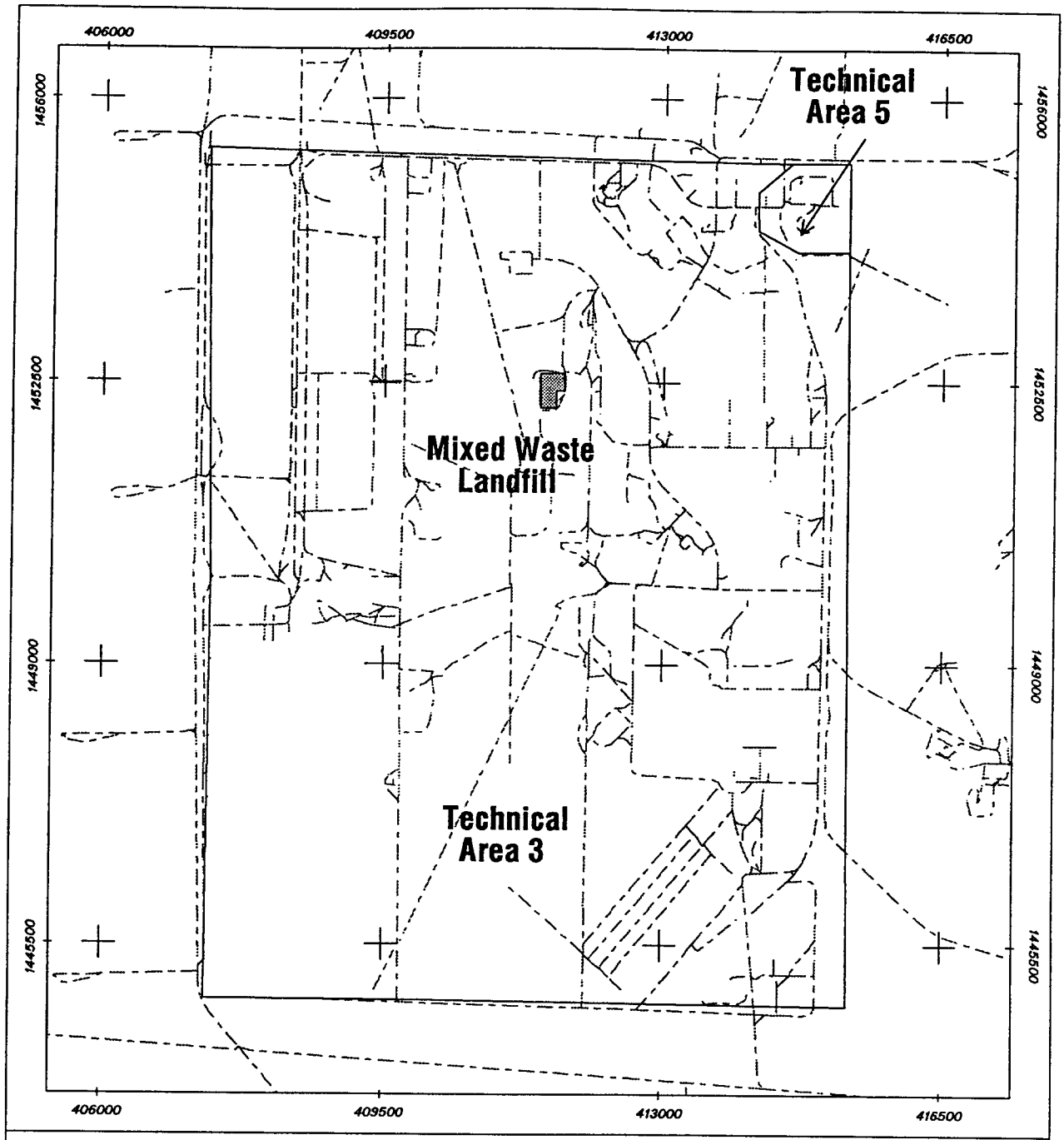

Legend

KAFB Roads

Technical Areas 3 and 5

Mixed Waste Landfill

Figure 1-2

Location of the Mixed Waste Landfill in Technical Area 3

0 1000 2000
Scale in Feet

0 240 480
Scale in Meters

N

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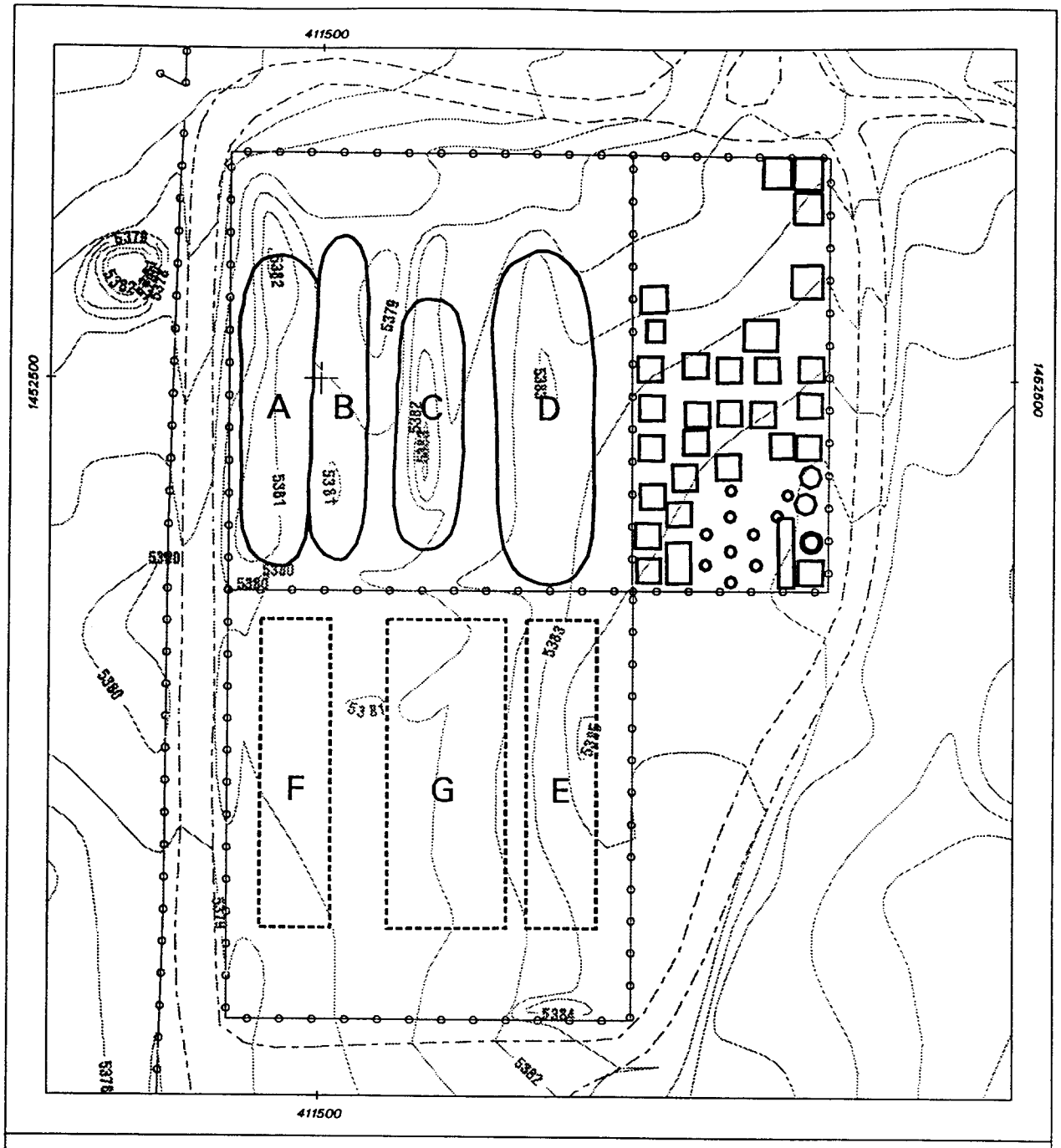

Legend

- Fences
- KAFB Roads
- One Foot Contours
- Pits and Trenches
- Trenches E, F, & G not actual; Engineering schematic only; Pending geophysical confirmation

Figure 1-3

Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

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plutonium-contaminated wastes, and plutonium-contaminated weapons test debris from the Nevada test site. Wastes disposed of in unclassified area trenches included construction and demolition materials, contaminated equipment and soils, lead shielding, wood crates, steel drums, lead bricks, cardboard boxes, and dry solids. Wastes were randomly disposed of in unclassified area trenches with no regard to waste source or type.

Mixed waste disposal in classified pits and unclassified trenches at the MWL is poorly documented. Disposal records that provide information concerning the composition, concentration/quantity, and disposal location(s) within the MWL for wastes which were unsuitable for disposal at the CWL do not exist. Figures that clearly denote the pits and trenches where mixed wastes were disposed of in the classified or unclassified areas do not exist. Mixed wastes known to have been disposed of in the classified area pits include organic acids, solvents (reported to be CCl_4 and TCE), oils and petroleum products, lead shielding, barium, beryllium, chromium, and toluene-based liquid scintillation cocktails. These wastes may have been disposed of in other pits and trenches throughout the landfill. It is believed, however, that little or no nonradioactive hazardous wastes were disposed of in the unclassified area of the MWL, since the CWL was established specifically for the disposal of nonradioactive, hazardous wastes.

2.0 SOIL GAS TECHNOLOGY

Soil gas sampling has been used extensively to detect a wide range of volatile organic compounds (VOCs) in soil under a variety of geologic and hydrologic settings. The most common uses of soil gas data include planning monitoring well networks and defining contaminant plume boundaries for remedial action. Preliminary screening techniques, such as soil gas sampling, are effective in selecting locations for detailed sampling and analysis (Marrin and Kerfoot, 1988).

There is no standard accepted method or procedure for soil gas sampling. Different laboratories prefer their own methodology and, as a result, there has not been any extensive comparison between methods. While quantitative trends within a site can be determined from soil gas data, quantitative comparison of soil gas data between sites is not reliable because of a variety of site-specific geologic and geotechnical factors. EPA's Remedial Response Data Quality Objectives cited soil gas measurements as a qualitative "yes-no" method for defining plume areal extent (EPA, 1987).

Soil gas sampling techniques fall into two categories: passive sampling and active sampling (dynamic grab sampling). Passive soil gas sampling provides an integrated measure of VOC concentrations over time, usually expressed in units of flux or some other arbitrary unit of measure such as "units." The technique averages out concentration fluctuations caused by changing environmental conditions and is effective in determining whether contamination is present, but is not considered to be quantitative. Passive sampling utilizes a charcoal or some type of sorbent to trap contaminants that diffuse through the soil gases over a period of days or weeks. The samples are then sent to an analytical laboratory where desorption and chemical analysis are performed (Marrin and Kerfoot, 1988).

Active soil gas sampling gives an instantaneous picture of the soil atmosphere at a particular subsurface location because samples are collected from a moving stream of soil gas that is pumped through a hollow probe or length of tubing. Samples can be analyzed on-site in a mobile laboratory or with portable instruments, or the samples can be sent off-site to an analytical laboratory for analysis. The results are normally expressed in quantitative units of measure such as parts per million (ppm) or parts per billion (ppb).

3.0 MWL PASSIVE SOIL GAS SAMPLING

3.1 EMFLUX^R Passive Soil Gas Sampling

Quadrel Services, Inc. was selected to perform the passive soil gas survey at the MWL because of their surface-based, or non-intrusive, sampling technology. Quadrel has developed a proprietary soil gas sampling method, EMFLUX^R, which is based on passive sampling of the soil gas emanation flux rate at the surface using a hemispherical flux chamber containing a proprietary adsorbent cartridge (Figure 3-1). Samples are typically collected over a 72-hour period and analyzed by GC/MS using Contract Laboratory Program (CLP) procedures. Transfer of the adsorbed gases from the cartridge into a GC/MS system is accomplished through the standard purge and trap sampling system (NETAC, 1989).

Two passive soil gas sampling surveys were conducted at the MWL during 1993. A total of 93 EMFLUX^R collection devices were deployed during the two sampling events. Analysis of the EMFLUX^R adsorbent cartridges was performed by Quadrel's contract laboratory, Maryland Spectral Services, Inc. (MSS), located in Baltimore, Maryland. MSS analyzed all EMFLUX^R sample cartridges with GC/MS equipment, using a modified EPA Method 8240 (Table 3-1). Each cartridge was analyzed for the VOCs specified on the EPA's standard Target Compound List (TCL) for the EPA Contract Laboratory Program (Table 3-2). The laboratory results, reported in nanograms of a specific contaminant recovered per cartridge, were then converted by Quadrel to average emission flux rates reported in nanograms per square meter per minute (ng/m^2/min), using the subtended area of the collector shell and the period of exposure for each sample.

In addition to the 93 field samples collected, nine control samples and two trip blanks were incorporated into the two rounds of sampling for QA/QC.

3.2 First Round EMFLUX^R Sample Results

The first round of passive soil gas sampling was conducted by Quadrel and SNL,NM personnel from July 30, 1993 to August 2, 1993. Seventy-one EMFLUX^R collection devices were deployed at the MWL. The first round sampling locations are shown in Figure 3-2. Of the 71 sample locations at the MWL, 51 were placed in the vicinity of the classified area of the landfill; 18 within the fenced perimeter of the classified area and 33 outside of the fenced perimeter of the classified area. The remaining 20 sample locations were placed in the unclassified area of the landfill. Sampling efforts were focused on the classified area for two reasons: 1) the southern half of the classified area was opened in March 1959 as the "Area III Radioactive Dump," and received all of the radioactive and mixed wastes from SNL,NM from 1959 until 1962. 2) historical records indicate that

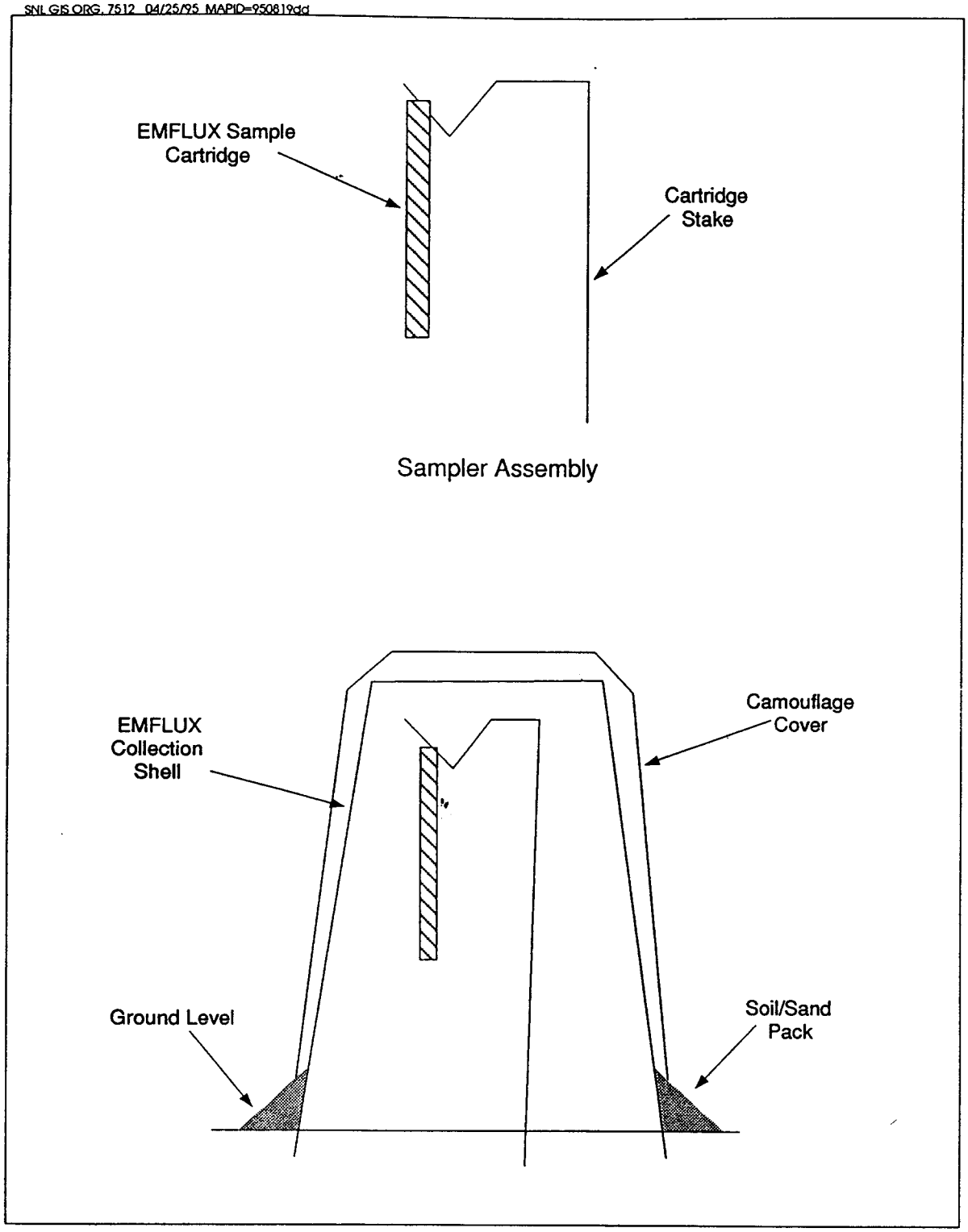


Figure 3 - 1. Passive Soil Gas Sampler Assembly and Collection Shell

Table 3-1. Laboratory Procedures for EMFLUX^{R} Adsorbent Cartridges, Modified 8240

After exposure, EMFLUX^{R} cartridges are analyzed as follows:

A. The GC/MS equipment to be used is calibrated in accordance with the EPA Contract Laboratory (CLP) method for low waters.

B. The exposed cartridge is placed in a Tekmar Autosampler chamber where it is desorbed at 270 degrees C for 11 minutes at 40 ml/min helium, through a sparging vessel containing five (5) ml of water with internal standards and surrogates into a three-component trap on a Tekmar Liquid Sample Concentrator. The three components in the secondary trap are Tenax, silica gel, and coconut charcoal.

C. The secondary trap is thermally desorbed at 220 degrees C into a Restek 502.2 capillary column, per the EPA CLP Statement of Work (SOW).

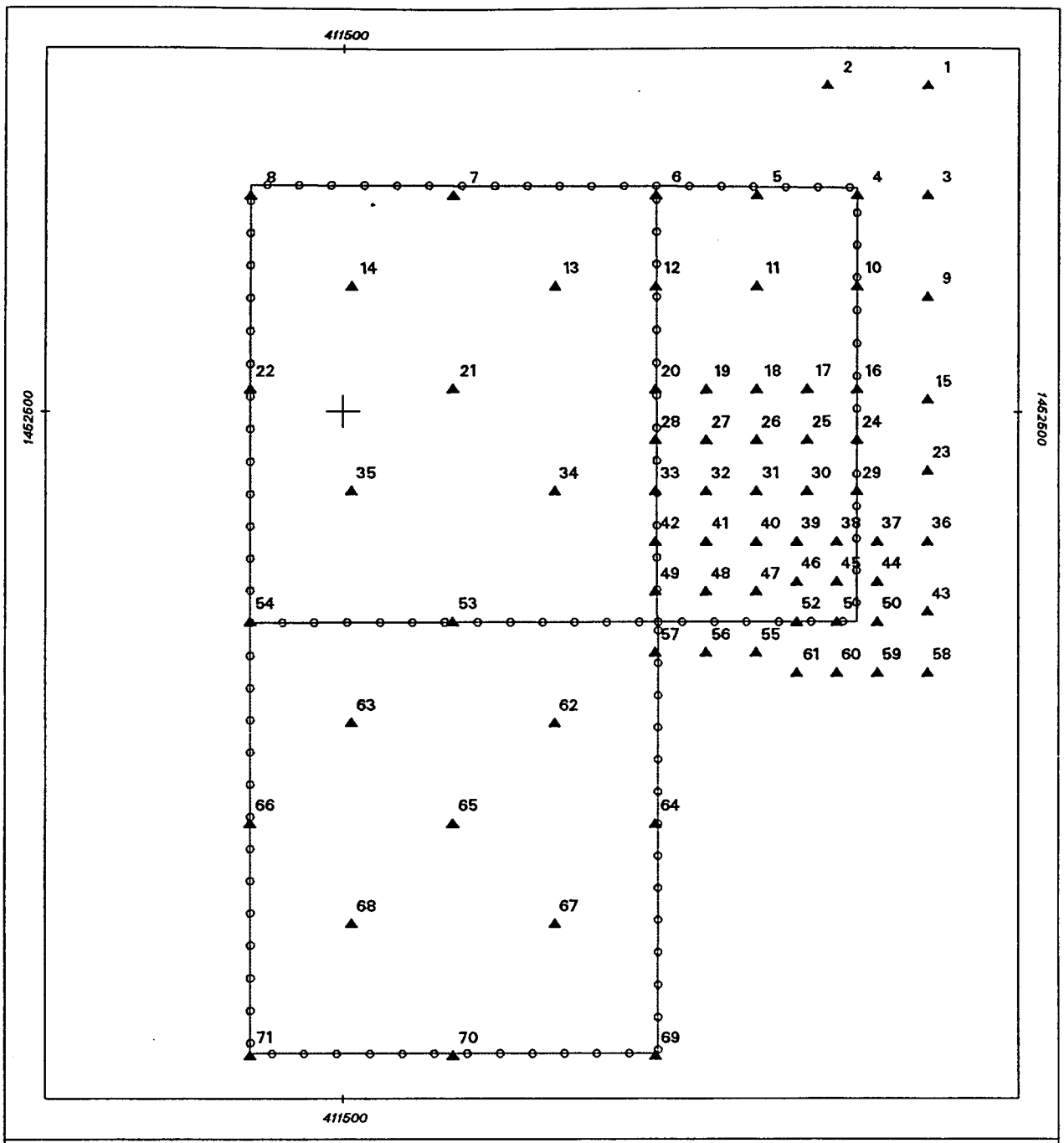
D. Following the SOW, the GC/MS is scanned between 35 and 260 Atomic Mass Units (AMU) at two (2) seconds per scan.

E. The internal standard method is used to determine the amounts of analytes found.

F. The compounds found are measured against five (5) ml of aqueous standard analyzed previously.

Table 3-2. Target Compound List for EPA Contract Laboratory Program

Acetone	1,2-Dichloropropane
Benzene	trans-1,3-Dichloropropene
Bromodichloromethane	cis-1,3-Dichloropropene
Bromoform	Ethylbenzene
Bromomethane	2-Hexanone
2-Butanone	4-methyl-2-pentanone
Carbon Disulfide	Methylene Chloride
Carbon Tetrachloride	Styrene
Chlorobenzene	1,1,2,2-Tetrachloroethane
Chloroethane	Tetrachloroethene
Chloroform	Toluene
Chloromethane	1,1,1-Trichloroethane
Dibromochloromethane	1,1,2-Trichloroethane
1,2-Dichloroethane	Trichloroethene
1,1-Dichloroethane	Vinyl Acetate
1,1-Dichloroethene	Vinyl Chloride
1,2-Dichloroethene (total)	Xylene



Legend

Fences

22 Sample locations

Figure 3-2

First Round Passive Soil Gas Sample Locations at the Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

spbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819j

most, if not all, of the mixed wastes disposed of at the landfill were placed in the classified area.

Results of the first round of passive soil gas sampling are shown in Table 3-3. The table provides the coordinates for each sample collected, the sample point number, and the flux rates of VOCs detected. Twelve VOCs were detected at above-background levels, and are discussed below.

3.2.1 Tetrachloroethene (Perchloroethene/PCE)

PCE was detected at 48 of the 71 locations sampled (Figure 3-3). The highest flux rates were reported within the fenced perimeter of the northern unclassified area. PCE flux rates reported at sample points 35, 21, 14, and 22 (see Figure 3-2) were 396.2 ng/m^2/min, 359.6 ng/m^2/min, 241.4 ng/m^2/min, and 199.9 ng/m^2/min, respectively. Sample points 35 and 14 are located directly above Trench B; sample point 21 is located directly above Trench C; and sample point 22 is located on the western boundary of Trench A (see Figure 1-3). The flux rates reported at sample points 13 (56.3 ng/m^2/min) and 34 (48.5 ng/m^2/min), directly above Trench D, were lower than the flux rates reported above or adjacent to the other three trenches. The remainder of the flux rate measurements, with the exception of sample points 8 (25.3 ng/m^2/min), 19 (23.8 ng/m^2/min), and 54 (22.6 ng/m^2/min), were below 12.8 ng/m^2/min. The PCE flux rates reported in the classified area were one to two orders of magnitude lower than the flux rates reported in the northern unclassified area.

3.2.2 Trichloroethene (TCE)

TCE was detected at 36 of the 71 locations sampled (Figure 3-4). Unlike PCE, the highest flux rates were reported in the classified area of the landfill. TCE flux rates reported at sample points 48, 18, and 47 (see Figure 3-2) were 327.4 ng/m^2/min, 190.1 ng/m^2/min, and 59.2 ng/m^2/min, respectively. The remainder of the flux rates reported in the classified area were below 22.7 ng/m^2/min. The flux rates reported in the northern unclassified area were well below the flux rates reported in the classified area. The two highest TCE flux rates in the northern unclassified area, 8.9 ng/m^2/min (sample point 14) and 6.7 ng/m^2/min (sample point 35), were measured directly above Trench B (Figure 1-3). TCE was detected at only two sample locations in the southern unclassified area.

3.2.3 1,1,1-Trichloroethane (TCA)

1,1,1-TCA was detected at 24 of the 71 locations sampled (Figure 3-5). The highest flux rate occurred at sample point 35 (23.5 ng/m^2/min) (Figure 3-2), directly above Trench B (Figure 1-3). All other levels of 1,1,1-TCA were at least an order of magnitude lower

Table 3-3. First Round Passive Soil Gas Emission Flux Rates (ng/m^2/min)[a], Mixed Waste Landfill July 30 through August 2, 1993

Sample Location X Coordinate[b] (feet)	Sample Location Y Coordinate[c] (feet)	Sample Number	tetrachloro-ethane (PCE)[d]	trichloro-ethene (TCE)[d]	1,1,1-trichloro-ethane (1,1,1-TCA)[d]	1,1,2-trichloro-trifluoroethane[d]	dichloro-ethyne[e]	toluene[d]	acetone[d]	isopropyl ether[d]	1,1-dichloro-ethene[d]	styrene[d]	ethyl-benzene[d]	xylene[d]
335	50	1	1.1	U	U	U	U	U	U	U	U	U	U	U
285	50	2	4.2	U	U	U	U	U	U	U	U	U	U	U
335	-5	3	U	U	U	U	U	U	U	U	U	U	U	U
300	-5	4	0.9	U	U	U	U	U	U	U	U	U	U	U
250	-5	5	3.5	U	U	U	U	U	U	U	U	U	U	U
200	-5	6	U	U	U	U	U	U	U	U	U	U	U	U
100	-5	7	45.5	3.7	U	U	U	1.3	U	U	U	U	U	U
0	-5	8	25.3	1.8	U	U	U	1	U	U	U	U	U	U
335	-55	9	U	U	U	U	U	U	U	U	U	U	U	U
300	-50	10	U	U	1	U	U	1	0.7	U	U	U	U	U
250	-50	11	0.8	1.1	U	U	U	U	U	U	U	U	U	U
200	-50	12	0.9	U	1.1	U	U	U	U	U	U	U	U	U
150	-50	13	56.3	2.1	U	U	U	1.8	3.6	U	U	U	U	0.8
50	-50	14	241.4	8.9	U	U	1.1	1.6	U	U	U	U	U	U
335	-105	15	U	U	U	U	U	U	U	U	U	U	U	U
300	-100	16	U	U	1.1	0.9	U	U	U	U	U	U	U	U
275	-100	17	2.5	2.8	U	U	1.3	U	U	U	U	U	U	U
250	-100	18	5.9	190.1	0.25	1.2	U	U	U	U	U	U	U	U
225	-100	19	23.8	17.8	U	U	2.3	1.4	U	U	U	U	U	U
200	-100	20	12.8	3.2	U	U	U	1	U	U	U	U	U	U
100	-100	21	359.6	1.3	1.1	U	U	1.6	U	U	U	U	U	U
0	-100	22	199.9	2.1	U	U	U	1.7	U	U	U	U	U	U
335	-140	23	U	U	U	U	U	U	U	U	U	U	U	U
300	-125	24	U	1.4	1.3	0.3	U	U	U	U	U	U	U	U
275	-125	25	2.5	3.9	U	U	0.9	U	U	U	U	U	U	U
250	-125	26	0.9	19	U	U	1.7	U	U	U	U	U	U	U

[a](ng/m^2/min) = nanograms per square meter per minute

[b]east: positive; west: negative

[c]north: positive; south: negative

[d]Volatile organics analyzed by EPA GC/MS method 8240 (modified)

[e]Dichloroethyne was tentatively identified by mass spectral comparison with the National Bureau of Standards Library

U = below reported quantitation level

Table 3-3. First Round Passive Soil Gas Emission Flux Rates (ng/m^2/min)[a], Mixed Waste Landfill July 30 through August 2, 1993 (continued)

Sample Location X Coordinate[b] (feet)	Sample Location Y Coordinate[c] (feet)	Sample Number	tetrachloro-ethane (PCE)[d]	trichloro-ethene (TCE)[d]	1,1,1-trichloro-ethane (1,1,1-TCA)[d]	1,1,2-trichloro-trifluoroethane[d]	dichloro-ethyne[e]	toluene[d]	acetone[d]	isopropyl ether[d]	1,1-dichloro-ethene[d]	styrene[d]	ethyl-benzene	xylene[d]
225	-125	27	4.1	7.2	U	U	1.7	U	U	U	U	U	U	U
200	-125	28	0.8	U	U	0.1	U	U	U	U	U	U	U	U
300	-150	29	U	U	1.2	U	U	U	U	U	U	U	U	U
275	-150	30	U	U	U	U	U	U	U	U	U	U	U	U
250	-150	31	3.1	2.7	U	U	1.3	1.1	U	U	U	U	U	U
225	-150	32	7.1	1.1	0.8	U	U	U	U	U	U	U	U	U
200	-150	33	1.7	1.7	1	U	U	U	U	U	U	U	U	U
150	-150	34	48.5	U	U	U	U	U	U	U	U	U	U	U
50	-150	35	396.2	6.7	23.5	U	U	2.2	U	U	1.3	U	U	U
335	-175	36	U	U	U	U	U	U	U	U	U	U	U	U
310	-175	37	U	U	1.2	0.1	U	U	U	U	U	U	U	U
290	-175	38	U	1.4	1.4	U	U	U	U	U	U	U	U	U
270	-175	39	3.8	5.7	U	U	U	U	U	0.9	U	U	1.2	U
250	-175	40	1.5	15.9	U	U	1.3	U	U	35.7	U	U	U	U
225	-175	41	U	U	U	U	U	U	U	U	U	U	U	U
200	-175	42	U	0.9	0.9	U	U	U	U	U	U	U	U	U
335	-210	43	U	U	U	U	U	U	U	U	U	U	U	U
310	-195	44	U	U	U	U	U	1	U	U	U	U	U	U
290	-195	45	U	2.4	0.9	U	1.4	U	U	U	U	U	U	U
270	-195	46	6.7	22.7	2	1	1.7	U	U	U	U	U	U	U
250	-200	47	5.4	59.2	U	U	0.9	1.1	U	U	U	U	U	U
225	-200	48	9.4	327.4	2.5	U	103.3	U	U	U	U	U	U	U
200	-200	49	1.6	2	2.1	U	U	U	U	U	U	U	U	U
310	-215	50	1.3	U	U	U	U	U	U	U	U	U	U	U
290	-215	51	U	1.7	1.1	0.2	U	U	U	U	U	U	U	U
270	-215	52	1.3	5.2	1.2	U	U	U	U	U	U	U	U	U

[a](ng/m^2/min) = nanograms per square meter per minute

[b]east: positive; west: negative

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[d]Volatile organics analyzed by EPA GC/MS method 8240 (modified)

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Table 3-3. First Round Passive Soil Gas Emission Flux Rates (ng/m^2/min)[a], Mixed Waste Landfill July 30 through August 2, 1993 (concluded)

Sample Location X Coordinate[b] (feet)	Sample Location Y Coordinate[c] (feet)	Sample Number	tetrachloro-ethane (PCE)[d]	trichloro-ethene (TCE)[d]	1,1,1-trichloro-ethane (1,1,1-TCA)[d]	1,1,2-trichloro-trifluoroethane[d]	dichloro-ethyne[e]	toluene[d]	acetone[d]	isopropyl ether[d]	1,1-dichloro-ethene[d]	styrene[d]	ethyl-benzene	xylene[d]
100	-215	53	1.2	U	0.9	0.2	U	U	U	U	U	U	U	U
0	-215	54	22.6	U	U	U	U	1.6	U	U	U	U	U	U
250	-230	55	7.1	3	U	U	U	U	U	U	U	U	U	U
225	-230	56	1.8	1.2	1.2	U	U	U	U	U	U	U	U	U
200	-230	57	4.4	1.4	2.3	0.2	U	U	3.9	U	U	U	U	U
335	-240	58	2.8	U	U	U	U	1.6	U	U	U	U	U	U
310	-240	59	U	U	U	U	U	U	U	U	U	1	U	U
290	-240	60	3.7	U	U	U	U	U	U	U	U	U	U	U
270	-240	61	3.7	0.8	U	U	U	U	U	U	U	U	U	U
150	-265	62	2.1	U	U	U	U	0.8	22	U	U	U	U	U
50	-265	63	7.3	U	U	U	U	1.9	17.2	U	U	U	U	U
200	-315	64	3.4	U	U	U	U	U	U	U	U	U	U	U
100	-315	65	1.4	U	U	U	U	U	U	U	U	U	U	U
0	-315	66	7	U	U	U	U	U	U	U	U	U	U	U
150	-365	67	5	1.1	0.8	U	U	U	8.7	U	U	U	U	U
50	-365	68	2.6	U	U	U	U	U	U	U	U	U	U	U
200	-430	69	U	U	0.8	U	U	U	U	U	U	U	U	U
100	-430	70	U	0.9	U	U	U	U	0.4	U	U	U	U	U
0	-430	71	U	U	U	U	U	U	1.5	U	U	U	U	U

[a](ng/m^2/min) = nanograms per square meter per minute

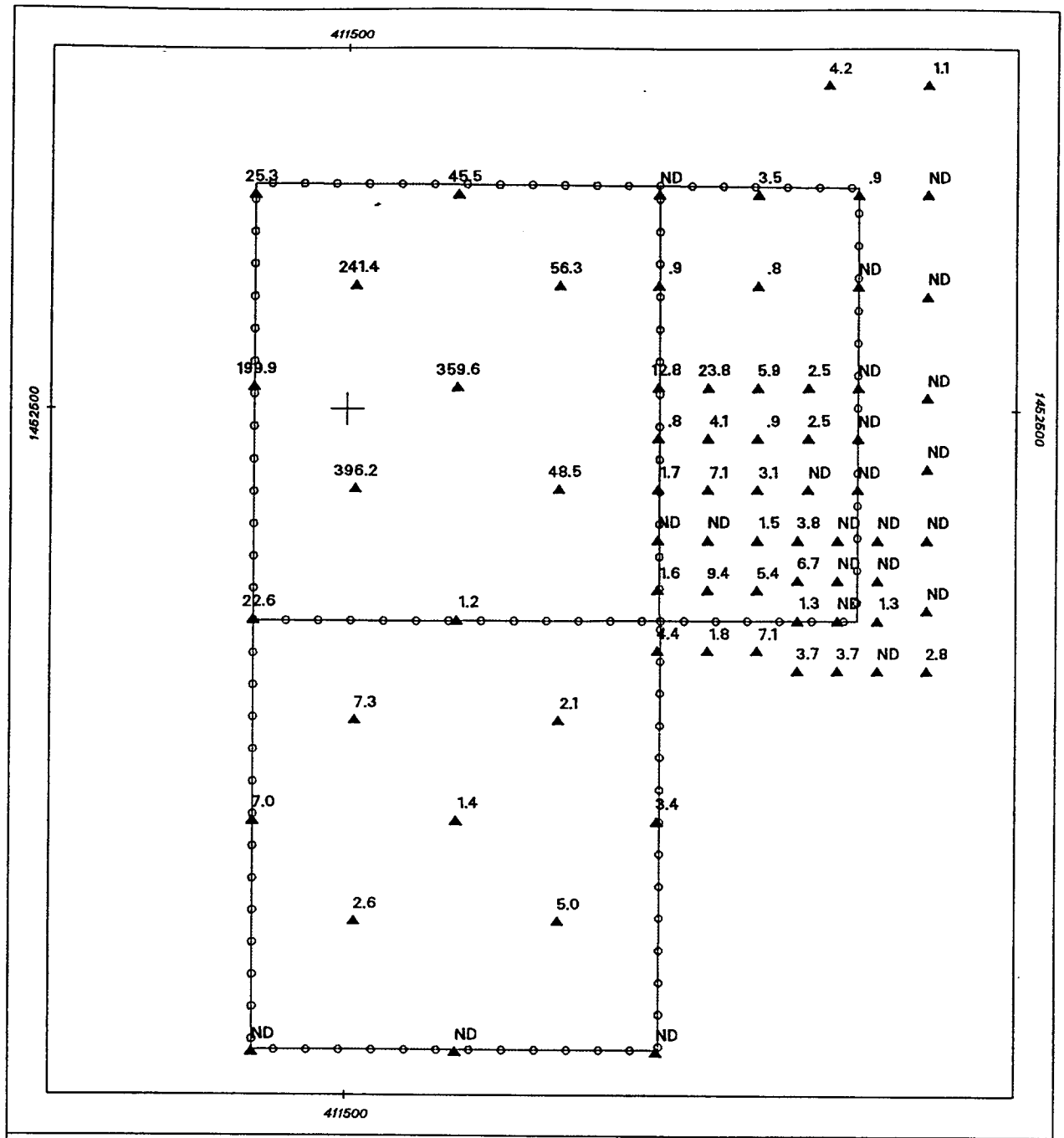
[b]east: positive; west: negative

[c]north: positive; south: negative

[d]Volatile organics analyzed by EPA GC/MS method 8240 (modified)

[e]Dichloroethyne was tentatively identified by mass spectral comparison with the National Bureau of Standards Library

U = below reported quantitation level



Legend

Fences

7.3 — Sample location and flux rate (first round)

ND — Not detected

Figure 3-3

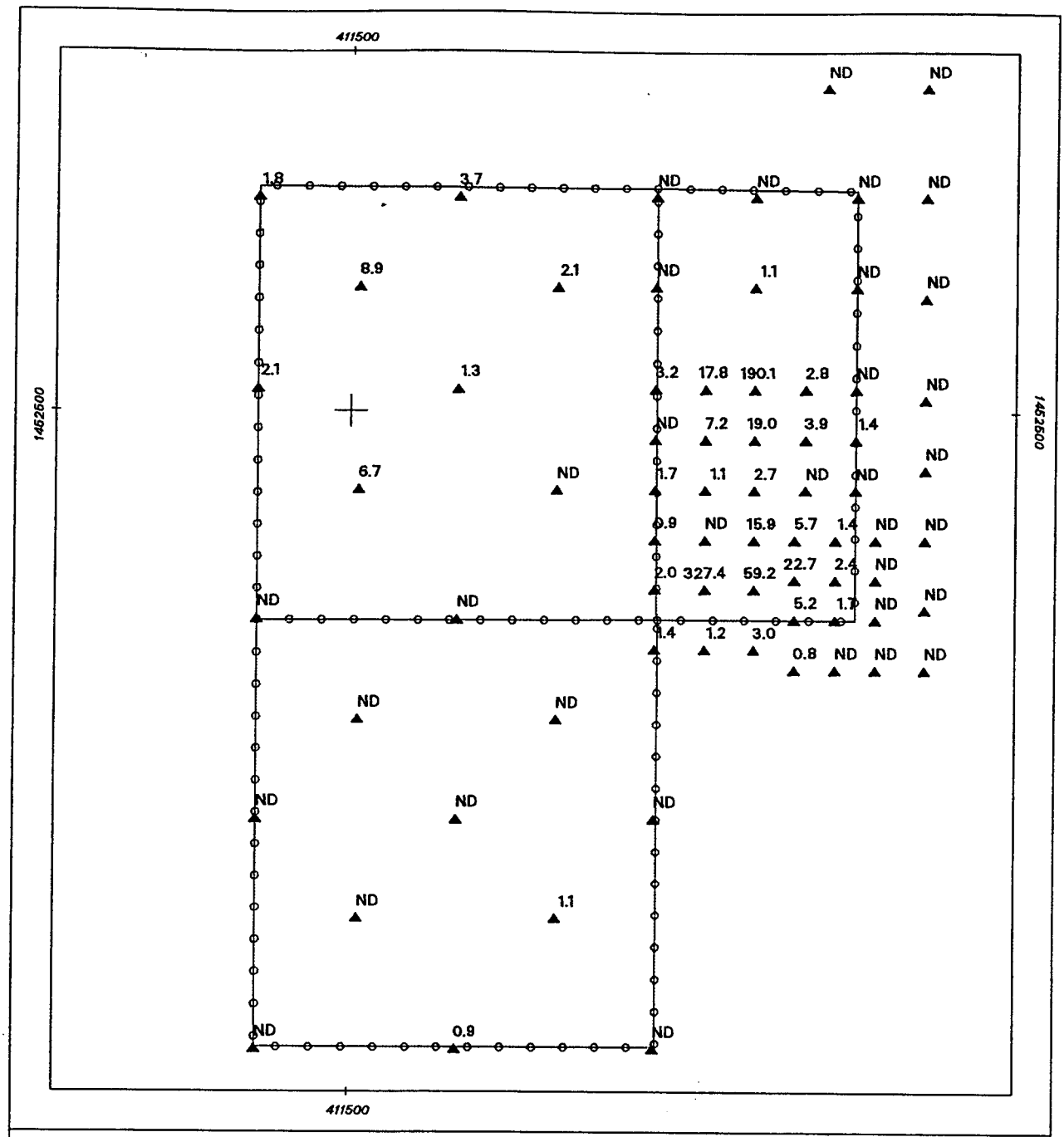
PCE Emission Flux Rate ($ng/m^2/min$), Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

spbroye SNL GIS ORG. 7512 04/25/95 MAPID=950819k



Legend

Fences

6.7 Sample location and flux rate (first round)

ND Not detected

Figure 3-4

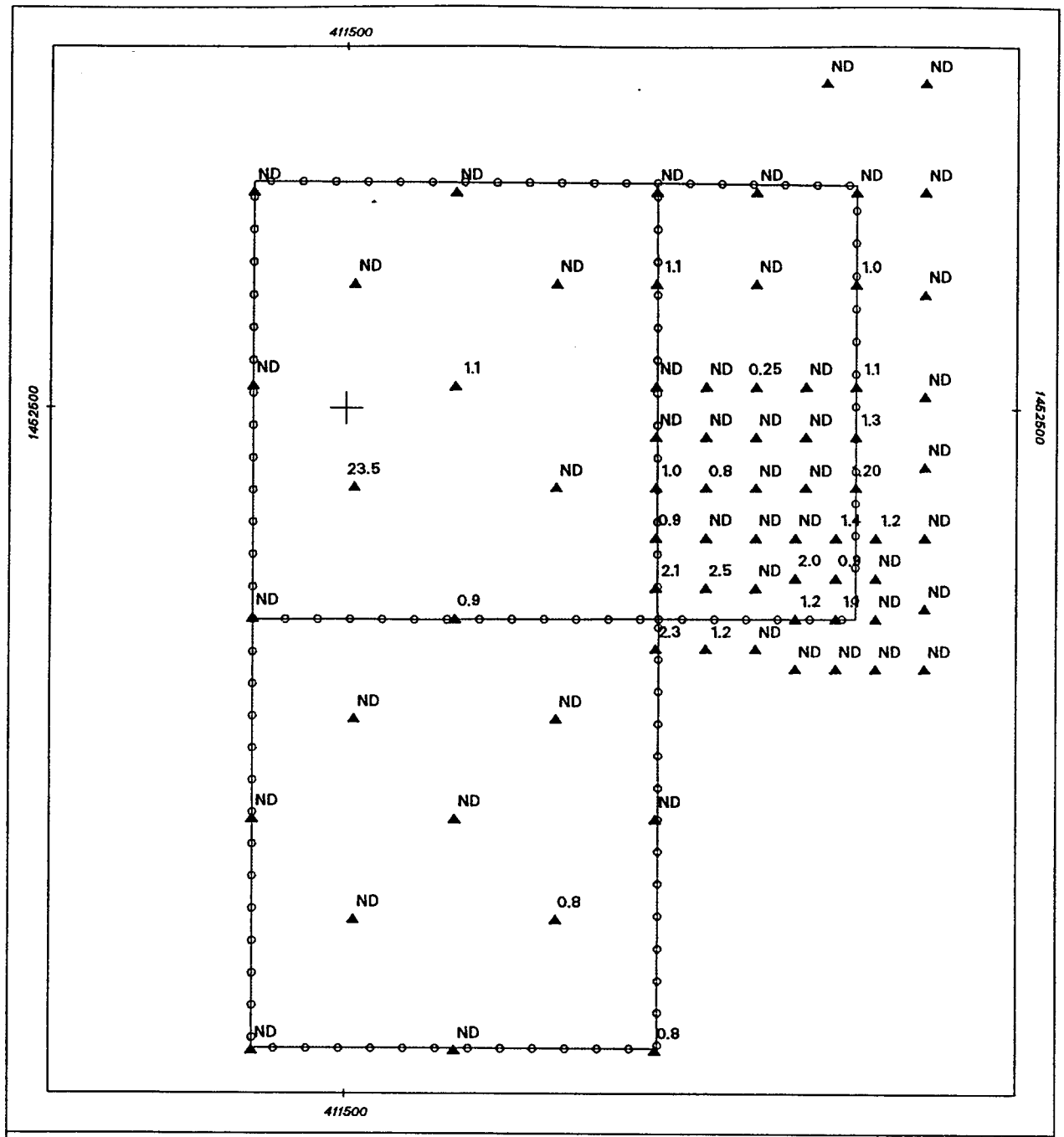
TCE Emission Flux Rate (ng/m^2/min), Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

epbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819I



Legend

Fences

23.5 — Sample location and flux rate (first round)

ND — Not detected

Figure 3-5

1,1,1-TCA Emission Flux Rate (ng/m^2/min), Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

spbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819m

than the flux rate reported at sample point 35. The highest flux rate reported in the classified area of the landfill was at sample point 48 (2.5 ng/m^2/min) in the southern half of the classified area. 1,1,1-TCA was detected at only two sample locations in the southern unclassified area.

3.2.4 Toluene, Ethylbenzene, Xylene

Toluene was detected at 17 of the 71 locations sampled (Figure 3-6). The highest flux rate occurred at sample point 35 (2.2 ng/m^2/min) (Figure 3-2), directly above Trench B (Figure 1-3). Of the remaining toluene flux rates reported, all but two of the values higher than 1.4 ng/m^2/min occurred in the northern unclassified area of the landfill above Trenches C and D, and adjacent to Trench A. A flux rate of 1.6 ng/m^2/min was reported at sample point 58, in the southeast corner of the classified area, outside of the fence. A flux rate of 1.9 ng/m^2/min was reported at sample point 63 in the southern unclassified area, directly above Trench F.

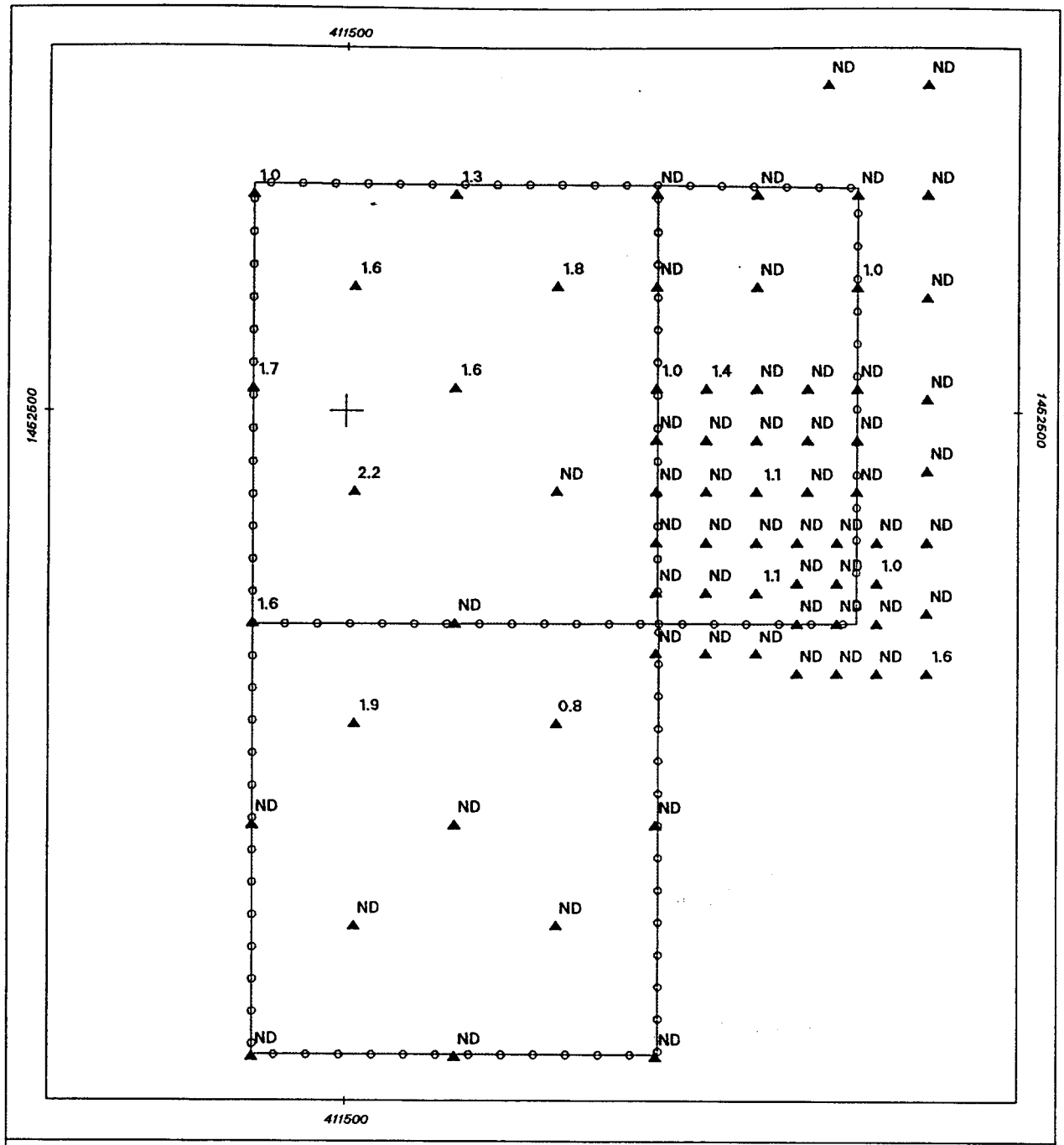
It is unlikely that the toluene detected is part of the common benzene, toluene, ethylbenzene, xylene (BTEX) grouping used to identify gasoline and other petroleum compounds. No benzene was reported at any of the sample locations; and, although ethylbenzene (1.2 ng/m^2/min at sample point 39) and xylene (0.8 ng/m^2/min at sample point 13) were reported, xylene was only detected with toluene at sample point 13 (Figure 3-2), above Trench D.

3.2.5 1,1,2-Trichlorotrifluoroethane

1,1,2-trichlorotrifluoroethane was detected at 9 of the 71 locations sampled, primarily within and along the boundaries of the classified area of the landfill (Figure 3-7). The highest flux rates were reported at sample points 18 (1.2 ng/m^2/min), 46 (1.0 ng/m^2/min), and 16 (0.9 ng/m^2/min) (Figure 3-2). The other six detections of the compound were below 0.3 ng/m^2/min.

3.2.6 Dichloroethyne

Dichloroethyne was tentatively identified by mass spectral comparison with the National Bureau of Standards library at 12 of the 71 locations sampled (Figure 3-8). Eleven of the sample locations where dichloroethyne occurred were within the fenced perimeter of the classified area of the landfill. The highest flux rate reported was at sample point 48 (103.3 ng/m^2/min). Dichloroethyne flux rates at this sample point were two orders of magnitude greater than any other dichloroethyne flux rate measured (Figure 3-2). Sample point 48 is also where the highest flux rate of TCE was reported. The next highest flux



Legend

Fences

2.2 Sample location and flux rate (first round)

ND Not detected

Figure 3-6

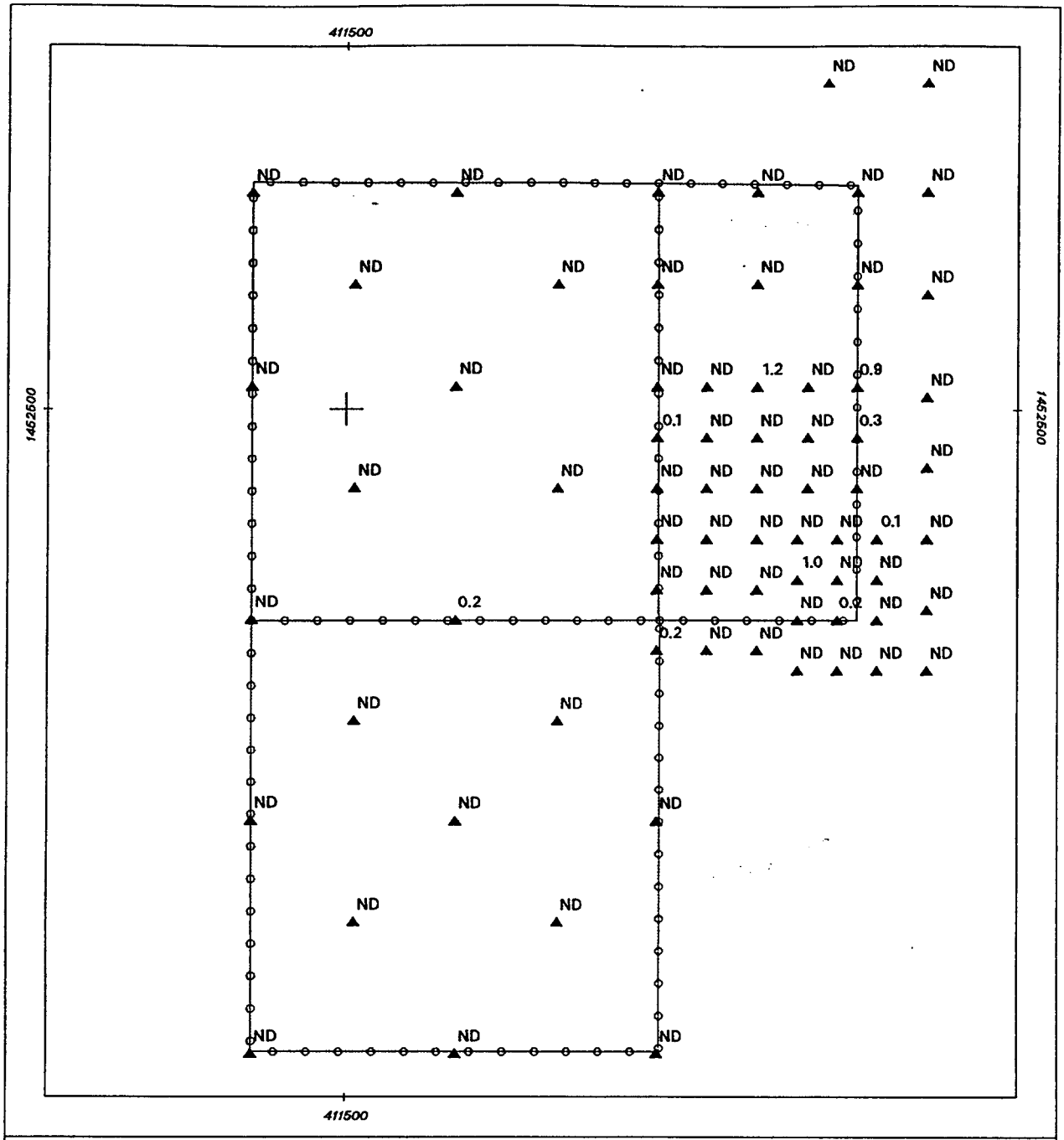
Toluene Emission Flux Rate (ng/m^2/min), Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 18.2
Scale in Meters

N

epbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819n



Legend

Fences

0.2 Sample location and flux rate (first round)

ND Not detected

Figure 3-7

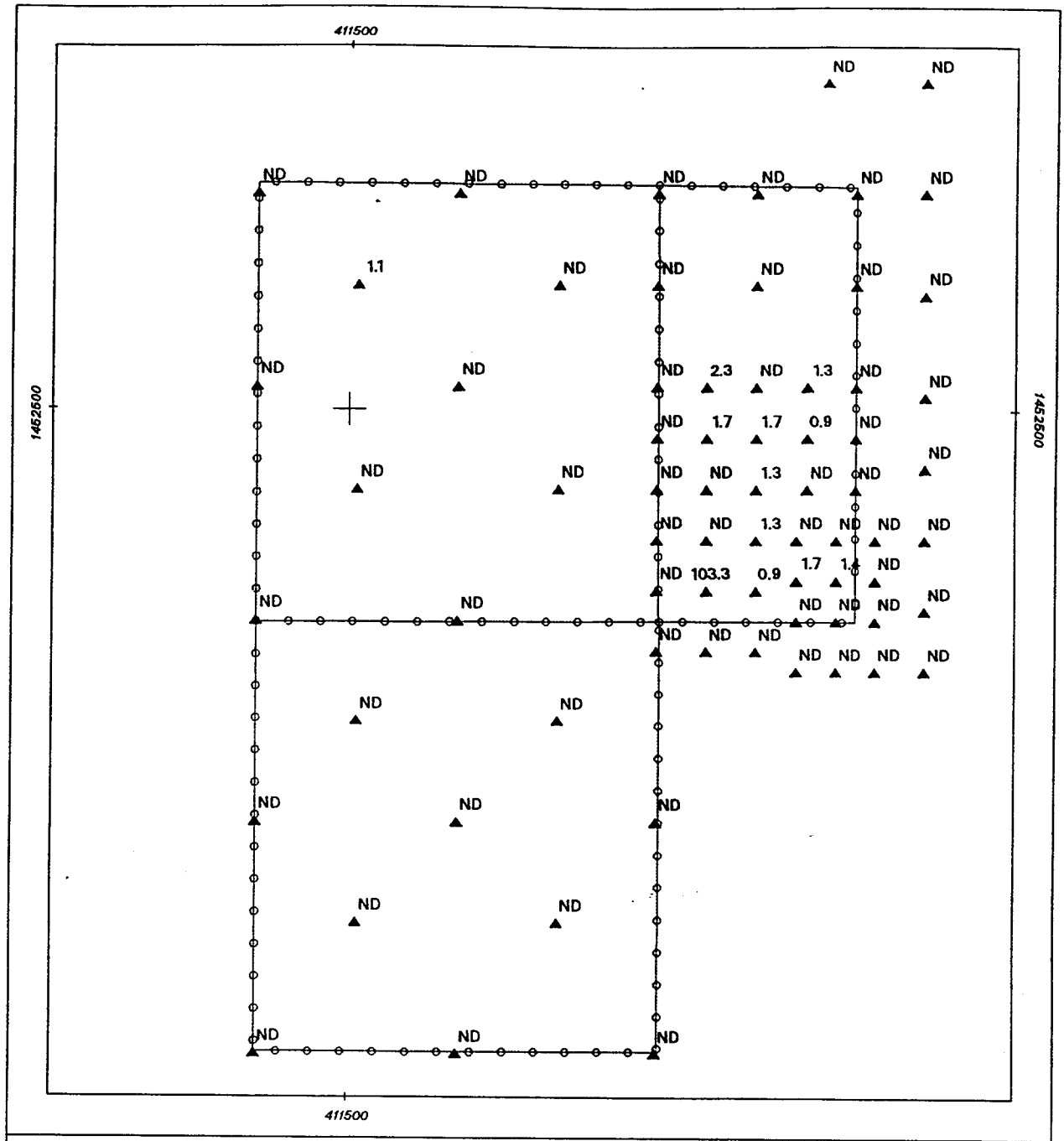
1,1,2-trichlorotrifluoroethane Emission Flux Rate ($ng/m^2/min$), Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

epbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819o



Legend

Fences

1.1 Sample location and flux rate (first round)

ND Not detected

Figure 3-8

Dichloroethyne Emission Flux Rate ($ng/m^2/min$), Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

spbreye SNL GIS ORG. 7512 04/25/95 MAPID=950619p

rate reported was at sample point 19 (2.3 ng/m^2/min). Dichloroethyne was reported at only one sample location (sample point 14) in the northern unclassified area. The compound was not detected in the southern unclassified area of the landfill.

3.2.7 Acetone

Acetone was detected at 8 of the 71 locations sampled (Figure 3-9). Six of the eight locations where acetone was detected were in the southern unclassified area of the landfill. The two highest flux rates were reported at sample points 62 (22 ng/m^2/min) and 63 (17.2 ng/m^2/min) (Figure 3-2), directly above Trenches E and F, respectively (Figure 1-3). A flux rate of 8.7 ng/m^2/min was also reported at sample point 67, directly above the southern portion of Trench E. The two remaining detections of acetone were reported in the northern unclassified area of the landfill, at sample point 13 (3.6 ng/m^2/min), and at sample point 10, located at the eastern fenced boundary of the classified area.

3.2.8 Other Compounds

Isopropyl ether was detected at two adjacent sample locations in the classified area of the landfill. The flux rate at sample point 40 (35.7 ng/m^2/min) was an order of magnitude greater than the flux rate at adjacent sample point 39 (0.9 ng/m^2/min).

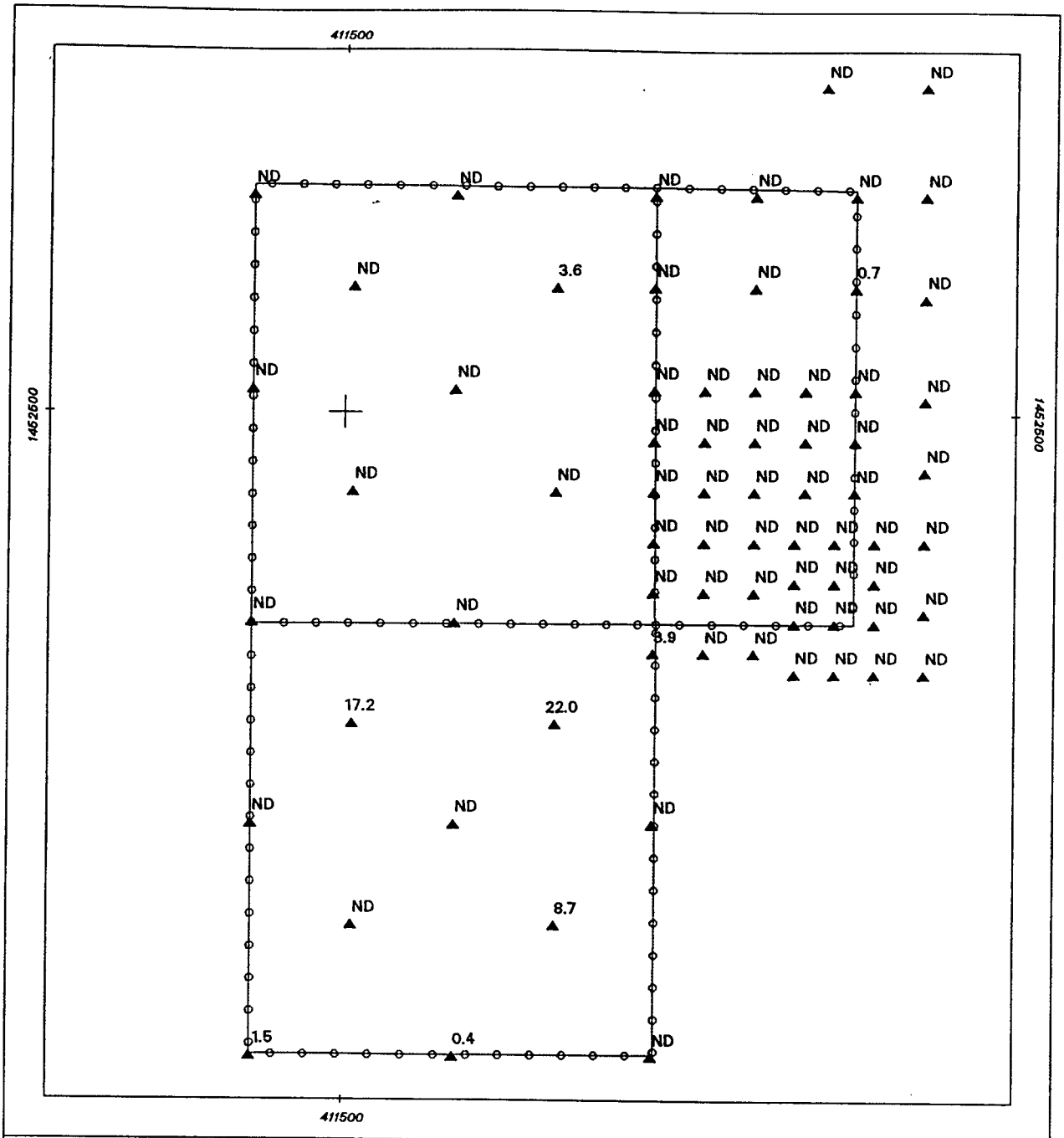
1,1-Dichloroethene, a by-product of 1,1,1-TCA, was detected at sample point 35 (1.3 ng/m^2/min) in the northern unclassified area of the landfill.

Styrene, a minor component of many petroleum products, was detected at sample point 59 at a flux rate of 1.0 ng/m^2/min.

3.3 Second Round EMFLUX^R Sample Results

A second round of passive soil gas sampling was conducted by SNL,NM personnel from September 15, 1993 to September 20, 1993. The second round of sampling was performed for three reasons: 1) to resample five locations that were sampled during the first round to verify the accuracy of the technique; 2) to delineate VOC flux rates west of the fenced perimeter of the landfill; and 3) to determine background VOC flux rates. To accomplish this, 22 EMFLUX^R collection devices were deployed at the MWL. The second round sampling locations are shown in Figure 3-10. Sample points 18, 19, 20, 21, and 22 were resampled locations (see Figure 3-2). Background sample locations are represented by sample points 13, 14, 15, 16, and 17.

Results of the second round of passive soil gas sampling at the MWL are shown in Table 3-4. The table provides the coordinates for each sample collected, the sample point



Legend

Fences

3.6 — Sample location and flux rate (first round)

ND — Not detected

Figure 3-9

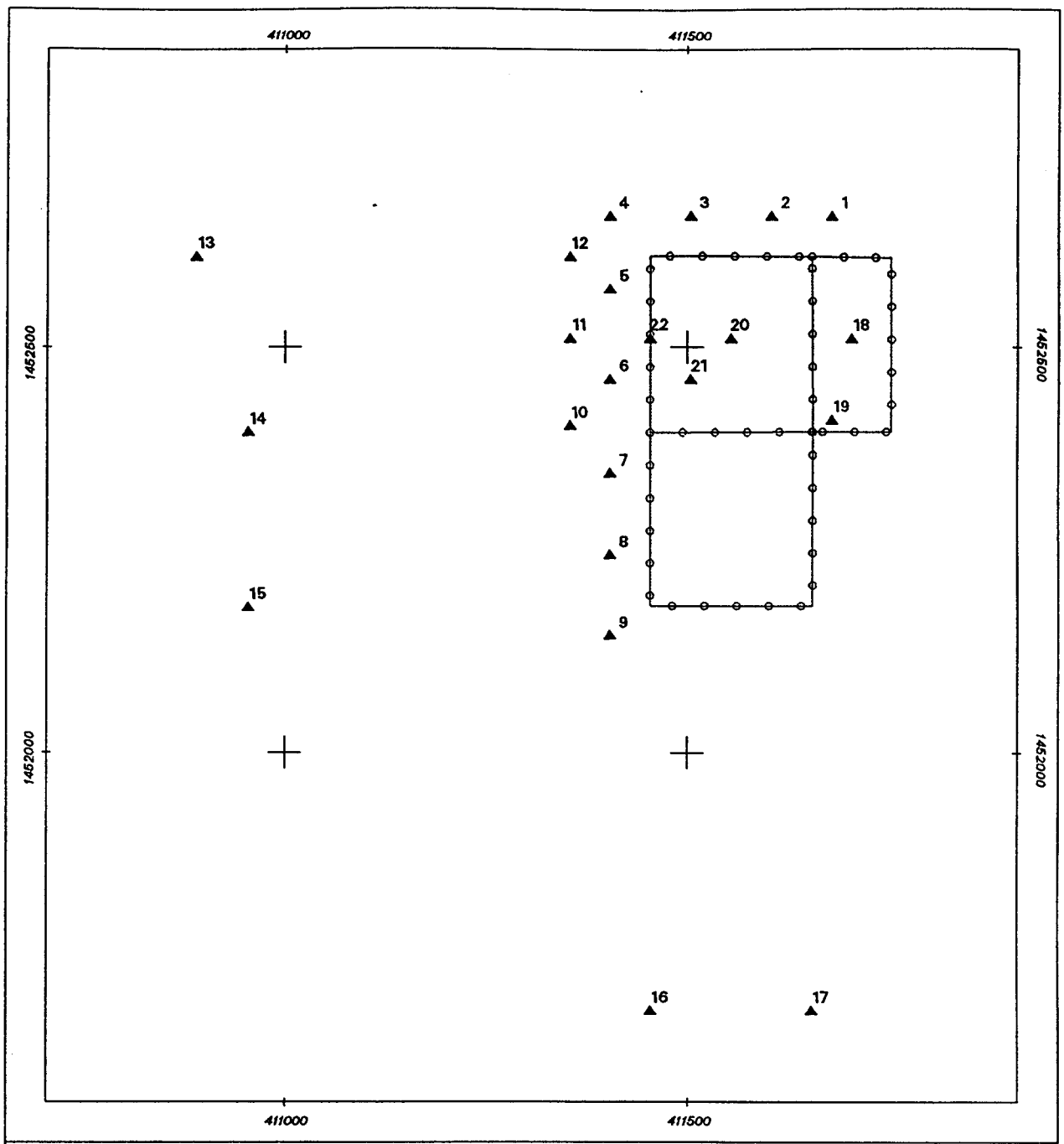
Acetone Emission Flux Rate (ng/m2/min), Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

epbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819q



Legend

Fences

Sample locations

Figure 3-10

Second Round Passive Soil Gas Sample Locations at the Mixed Waste Landfill

0 100 200
Scale in Feet

0 24 48
Scale in Meters

N

spbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819t

Table 3-4. Second Round Passive Soil Gas Emission Flux Rates (ng/m^2/min)[a], Mixed Waste Landfill September 15 through September 20, 1993

Sample Location X Coordinate[b] (feet)	Sample Location Y Coordinate[c] (feet)	Sample Number	tetrachloro-ethane (PCE)[d]	trichloro-ethene (TCE)[d]	1,1,1-trichloro-ethane (1,1,1-TCA)[d]	1,1-dichloro-ethene[d]
225	50	1	11.5	1.1	U	U
150	50	2	7.5	U	U	U
50	50	3	17.6	U	U	U
-50	50	4	9.1	U	U	U
-50	-40	5	27.5	1.7	U	U
-50	-150	6	15.2	0.9	U	U
-50	-265	7	5.1	0.6	U	U
-50	-365	8	1.1	0.6	U	U
-50	-465	9	U	U	U	U
-100	-207	10	NA	NA	NA	NA
-100	-100	11	12.6	0.9	U	U
-100	0	12	3.6	U	U	U
-564	0	13	U	U	U	U
-500	-215	14	U	U	U	U
-500	-430	15	U	U	U	U
0	-930	16	U	U	U	U
200	-930	17	U	U	U	U
250	-100	18[e]	18.6	129.1	0.6	U
225	-200	19[e]	16	158	1.4	U
100	-100	20[e]	164.4	0.74	0.9	U
50	-150	21[e]	220.7	3.2	15.7	1.6
0	-100	22[e]	66.7	0.6	U	U

[a](ng/m^2/min) = nanograms per square meter per minute

[b]east: positive; west: negative

[c]north: positive; south: negative

[d]Volatile organics analyzed by EPA GC/MS method 8240 (modified)

[e]Sample numbers 18 through 22 were resampled first round locations for purposes of verification

NA = not analyzed (sample number 10 was lost due to laboratory equipment malfunction)

U = below reported quantitation level

number, and the flux rates of VOCs detected. Four VOCs were detected at above-background levels. Owing to an instrument malfunction in the laboratory, sample point 10 (see Figure 3-10) was lost; therefore, the number of samples actually analyzed was reduced to 21. A discussion of the VOCs detected is presented below.

3.3.1 Tetrachloroethene (Perchloroethene/PCE)

PCE was detected at 15 of the 21 locations sampled (Figure 3-11). The highest flux rates reported were at sample points 21 (220.7 ng/m^2/min) and 20 (164.4 ng/m^2/min) in the northern unclassified area of the landfill (Figure 3-10), directly above Trenches B and C (Figure 1-3), respectively. A flux rate of 66.7 ng/m^2/min was reported at sample point 22, adjacent to Trench A . The flux rates reported during the second round of sampling correspond well with the flux rates reported at the same locations during the first round of sampling (see Figure 3-3). All other flux rates reported to the north and west of the landfill were at least an order of magnitude lower than the flux rates reported at sample points 21 and 20.

3.3.2 Trichloroethene (TCE)

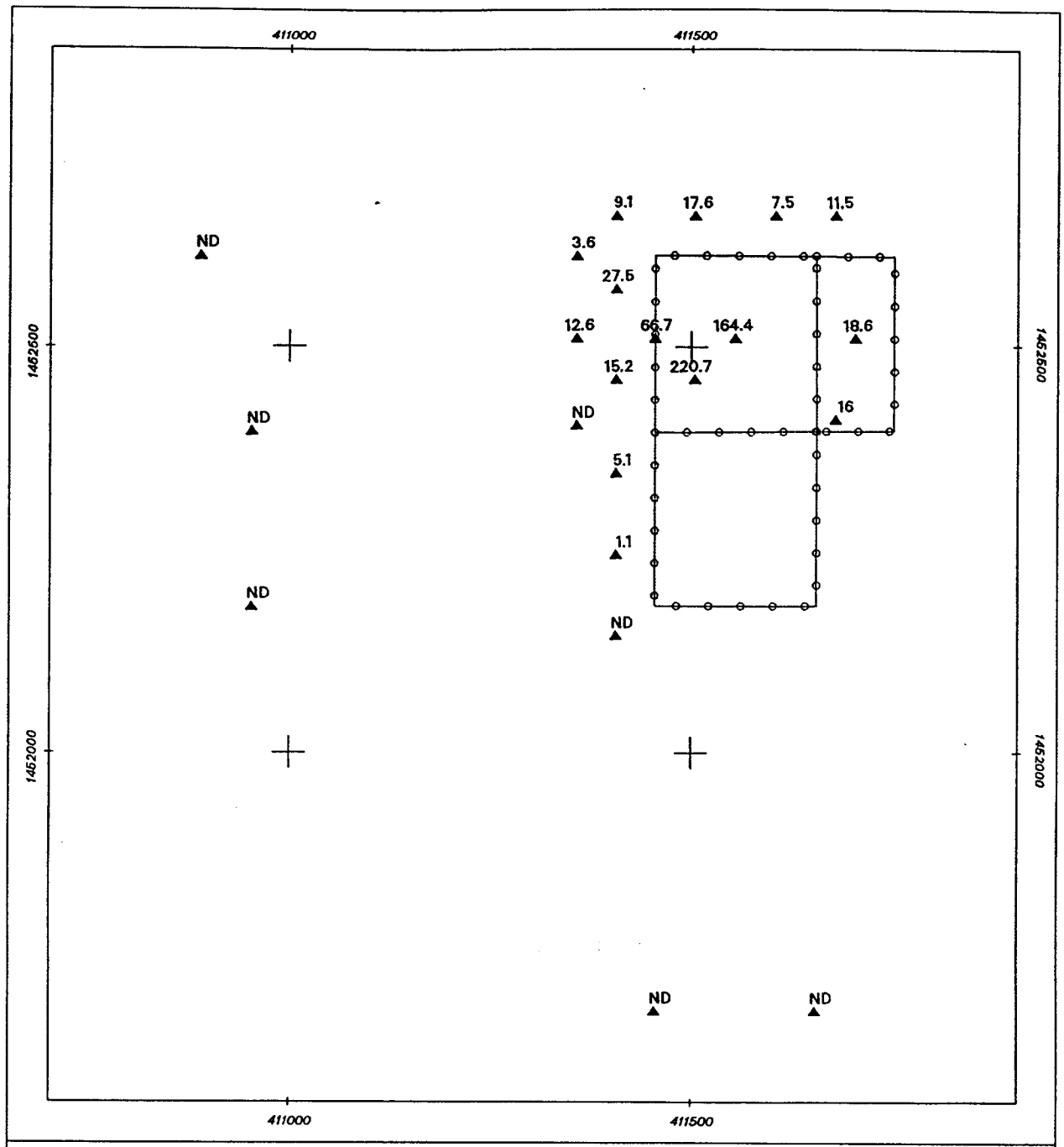
TCE was detected at 11 of the 21 locations sampled (Figure 3-12). The highest flux rates reported were at sample points 19 (158 ng/m^2/min) and 18 (129.1 ng/m^2/min) in the classified area of the landfill (Figure 3-10). Again, the results of the second round correspond well with the results of the first round (see Figure 3-4). All other TCE flux rates reported during the second round of sampling were at least two orders of magnitude lower than flux rates reported at sample points 19 and 18.

3.3.3 1,1,1-Trichloroethane (TCA)

1,1,1-TCA was detected at 4 of the 21 locations sampled (Figure 3-13). The highest flux rate was reported at sample point 21 (15.7 ng/m^2/min) in the northern unclassified area of the landfill (Figure 3-10). A flux rate of 1.4 ng/m^2/min, an order of magnitude lower than the flux rate at sample point 21, was reported at sample point 19 in the classified area of the landfill. These results correspond well with the first round sample results where the same two sample points showed the highest flux rates of 1,1,1-TCA (see Figure 3-5).

3.3.4 1,1-Dichloroethene

1,1-dichloroethene was detected at sample point 21 (1.6 ng/m^2/min) in the northern unclassified area of the landfill. The compound was detected at the same sample location



Legend

Fences

15.2 Sample location and flux rate (second round)

ND Not detected

Figure 3-11

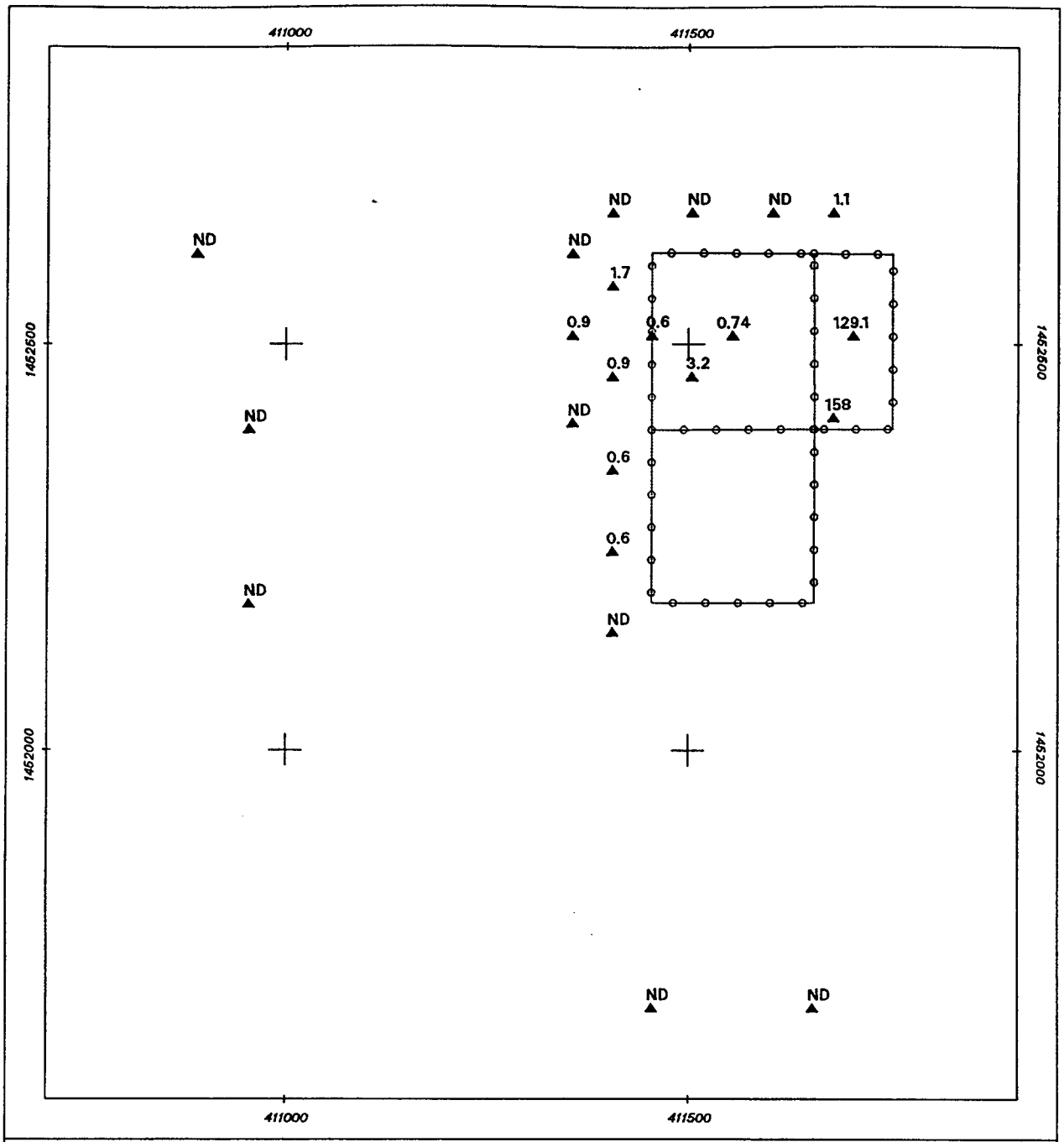
PCE Emission Flux Rate (ng/m2/min), Mixed Waste Landfill

0 100 200
Scale in Feet

0 24 48
Scale in Meters

N

epbreye SNL GIS ORG. 7512 04/25/96 MAPID=950819r



Legend

Fences

3.2 — Sample location and flux rate (second round)

ND — Not detected

Figure 3-12

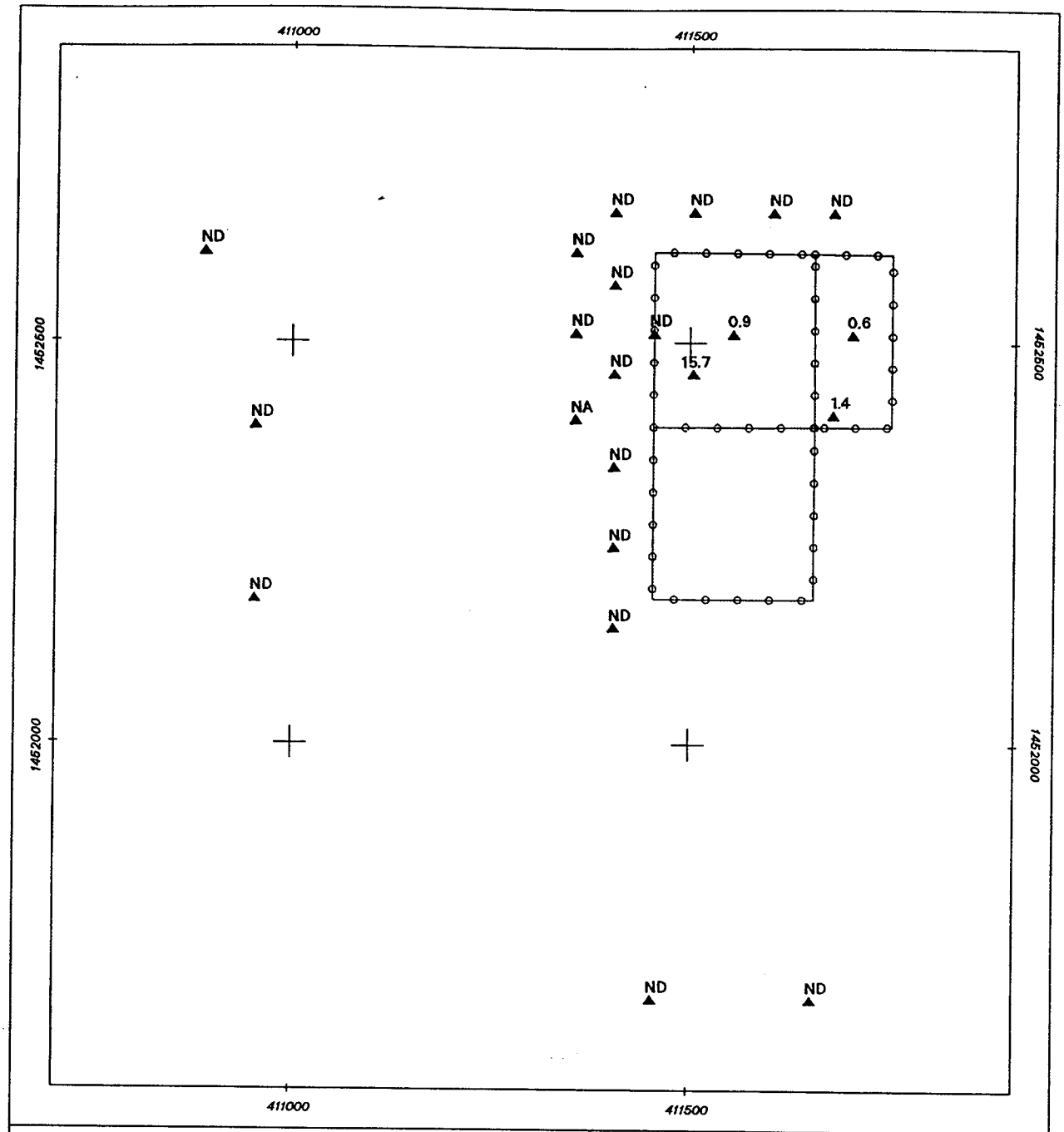
TCE Emission Flux Rate (ng/m^2/min), Mixed Waste Landfill

0 100 200
Scale in Feet

0 24 48
Scale in Meters

N

spbreys SNL GIS ORG. 7512 04/25/95 MAPID=950819c



Legend

Fences

15.7 — Sample location and flux rate (second round)

ND — Not detected

Figure 3-13

1,1,1-TCA Emission Flux Rate (ng/m^2/min), Mixed Waste Landfill

Scale in Feet: 0 100 200

Scale in Meters: 0 24 48

N

cpbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819u

(sample point 35) during the first round passive soil gas survey. No other detections of this compound were reported during the first or second round passive soil gas surveys.

3.3.5 Background Sample Locations

Analysis of the background passive soil gas samples collected from locations west and south of the landfill boundaries showed no VOC compounds when analyzed by MSS.

4.0 MWL ACTIVE SOIL GAS SAMPLING

Results of the 1993 EMFLUX^R passive soil gas sampling at the MWL identified 12 VOCs in soil gas. As discussed in Section 2.0, passive soil gas technology is an excellent tool for determining whether contamination is exists, but it is not considered to be a quantitative technique. For this reason, active soil gas sampling was conducted at the MWL as a quantitative follow-up to the passive soil gas sampling. There were four reasons for conducting a follow-up quantitative sampling program: 1) to provide a comparison of the concentration of VOCs present in soil gas at the MWL with the concentrations of VOCs present in soil gas at the CWL, where VOC contamination is known to exist, using 100 parts per million by volume (ppmv) total-VOC plume definition as a general guideline; 2) to provide VOC gradient information at two different depths; 3) to provide quantitative data that can be used for risk assessment; and 4) to aid in determining the location of boreholes for MWL Phase 2 RFI assessment activities.

During May and June of 1992, an active soil gas survey was conducted at the Chemical Waste Landfill (CWL) in Tech Area 3 at SNL,NM (SNL, 1993). Because no regulatory "action levels" exist to aid in determining what soil gas concentrations should trigger remedial action, an agreement between the New Mexico Environment Department (NMED) and the SNL,NM ER Project was reached during development of the CWL Closure Plan. The decision was that a level of 100 ppmv total-VOCs, as determined by active soil gas sampling, would define the edge of the contaminant plume. Total VOC concentrations less than 100 ppmv were considered below regulatory concern. The 100 ppmv value is a site characterization action level borrowed from the NMED Environmental Improvement Board's Underground Storage Tank Regulations. Total-VOCs refers to the sum of each of the target VOCs at each sample location.

The following presents the results of three rounds of active soil gas sampling conducted at the MWL. The first round of sampling was performed in June, 1994; the second round was performed in August, 1994; and the third round was performed in October, 1994. Personnel from IT Corporation and SNL,NM conducted the active soil gas sampling in accordance with ER Project Field Operating Procedure (FOP) 94-21, Shallow Soil Gas Sampling (SNL, 1994).

4.1 Active Soil Gas Sample Locations

Active soil gas sampling locations were based, where possible, on passive soil gas sampling results. Where passive soil gas sampling showed elevated VOC flux rates, active soil gas sampling was conducted at or within close proximity to the passive soil gas sample location (i.e., the northern unclassified area). In many instances, however, it was not possible to sample at locations where elevated passive soil gas flux rates were

measured. For example, it was not possible to sample within the fenced perimeter of the southern unclassified area or within the fenced perimeter of the classified area. Sampling could not be conducted in the southern unclassified area for two reasons: 1) the area is currently being used for temporary, aboveground storage of radioactive and mixed waste; and 2) precise trench locations are pending geophysical confirmation. Sampling was not attempted within the classified area because it would not be possible to safely maneuver the truck-mounted GeoProbe between the pits. Although active soil gas samples could not be collected in these two areas, samples were collected outside the fenced perimeter of both areas (Figure 4-1).

Three rounds of active soil gas sampling were conducted at the MWL. Nineteen soil gas samples were collected during the first round; 12 were collected during the second round; and 12 were collected during the third round. At each of the locations, two samples were taken; one at 10 feet and one at 30 feet below ground surface (bgs). The sample locations for each of the three rounds of sampling are shown in Figure 4-1.

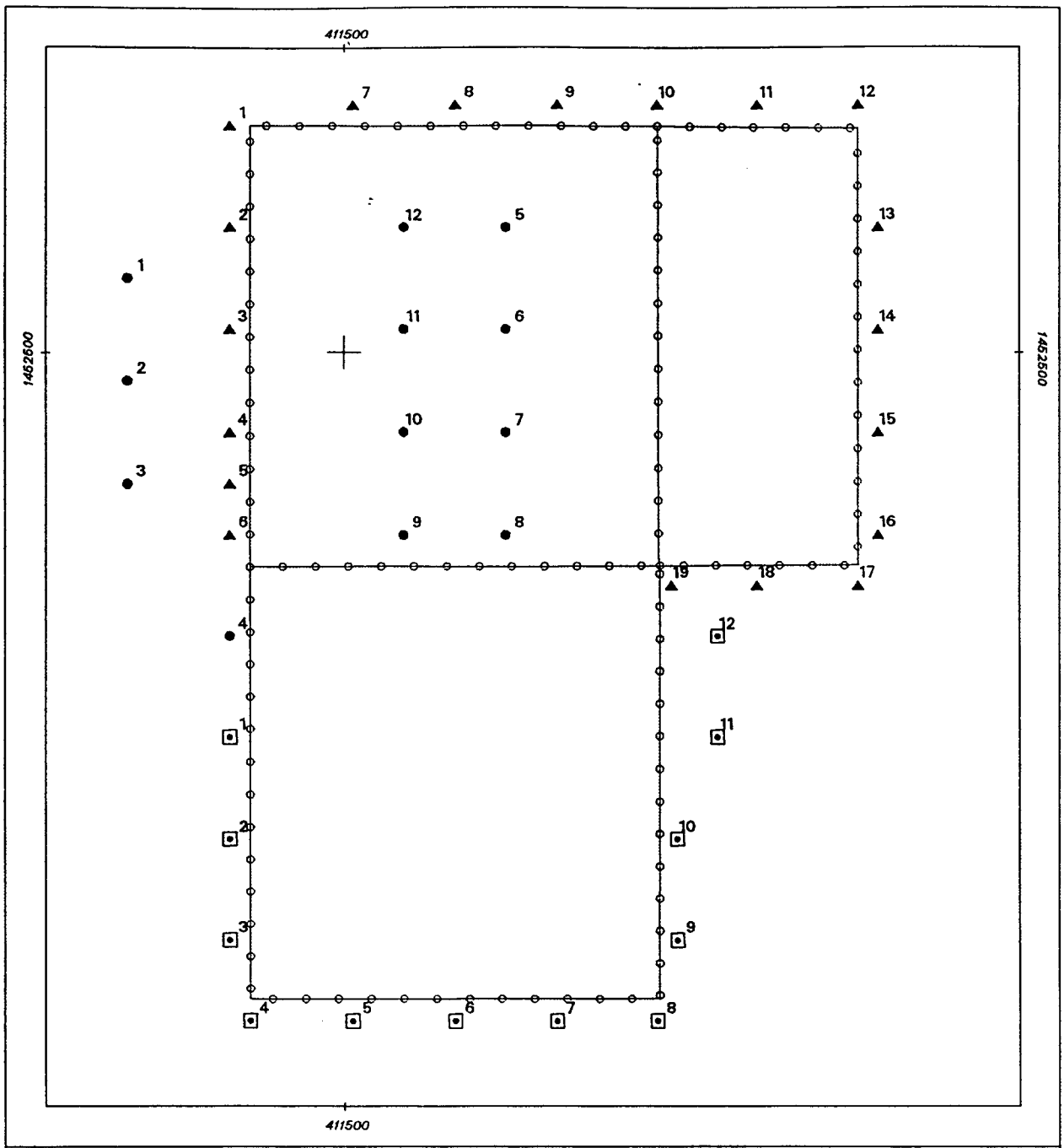
4.2 Sample Collection Equipment

Active soil gas samples were collected using a modified version of the soil gas collection system manufactured by GeoProbe Inc. The system consists of a truck-mounted hydraulic hammer, three-foot lengths of steel drive pipe, reusable hardened steel drivepoints, disposable polyethylene tubing, and a constant-discharge air pump. Figure 4-2 illustrates the sampling equipment used during the soil gas sampling. The GeoProbe system was modified by substituting a low-flow air pump for the GeoProbe-supplied vacuum pump. The modification allowed for monitoring of the exhaust gas prior to and during the sample collection process. Monitoring of the exhaust gas helped to define the appropriate time to pull a sample.

First round soil gas samples were collected in two different types of containers: 1) 500 ml glass septum-port gas sampling bulbs with teflon stopcocks, and 2) 6-liter SUMMA canisters. The first round samples taken at 10 feet bgs were collected in glass bulbs only. The first round samples taken at 30 feet bgs were collected in both glass bulbs and SUMMA canisters. Second and third round soil gas samples from both 10 feet and 30 feet bgs were collected in SUMMA canisters. A SUMMA canister consists of an aluminum, 6-liter container that is evacuated by the laboratory to create a vacuum.

4.3 Sample Collection Procedures

Active soil gas sampling was performed by driving a steel sample pipe with a reusable drivepoint to the desired sample depth using the GeoProbe hydraulic hammer. At the desired sample depth, the drive pipe was retracted approximately 3 inches to create a void space between the drivepoint and the end of the drive pipe. A polyethylene sample tube



Legend

Fences

First round sample locations

Second round sample locations

Third round sample locations

Figure 4-1

Active Soil Gas Sample Locations at the Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

spbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819v

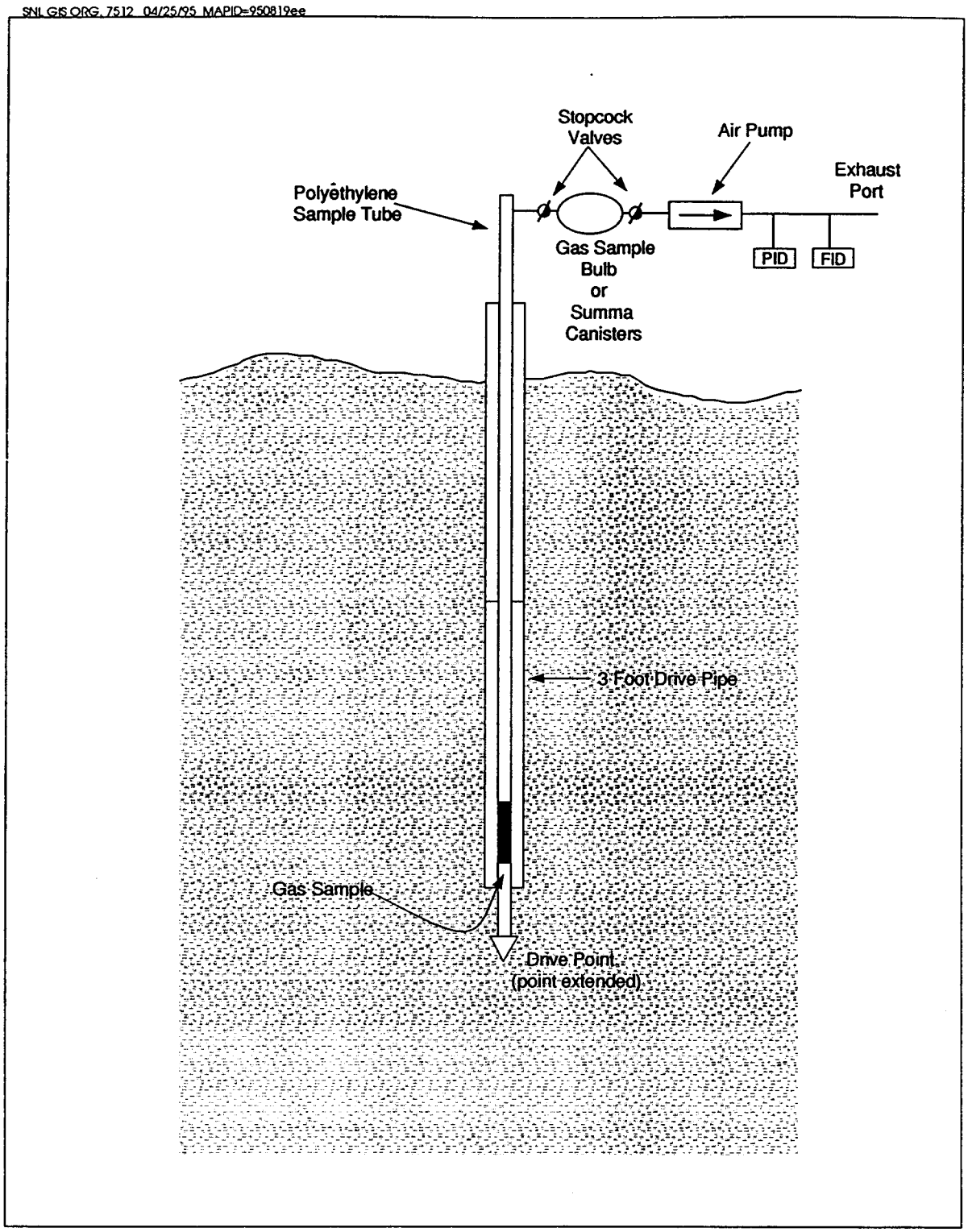


Figure 4-2. Active Soil Gas Sampling Equipment

was then inserted down the drive pipe and threaded onto the drivepoint. The upper end of the polyethylene sample tube was then connected to the influent port of the gas-sampling box. The gas-sampling box contained a 110-volt air-pump, a flow regulator, two three-way valves (upper and lower), a vacuum gauge, an air-flow gauge, two threaded sampling ports (upper and lower), a threaded air inlet port, and an air exhaust tee with two threaded ports. Under normal operation, air is drawn by the air pump into the back of the gas-sampling box via 1/4-inch polyethylene tubing. Air enters through the air inlet port, interacts with the flow regulator and the gauges, and exits through the air exhaust port. The two three-way valves can be used to isolate part of the tubing within the gas-sampling box to allow either purging or sampling from either the upper (SUMMA) port or the lower (glass bulb) port. The tee fitting at the exhaust port allows photoionization detector (PID) and flame ionization detector (FID) monitoring of the VOC exhaust stream without blocking gas flow.

All field equipment for soil gas sampling was decontaminated prior to sampling at each location. The GeoProbe drive pipe and drivepoints were washed with a solution of alconox and distilled water, rinsed with distilled water, and allowed to air-dry. Polyethylene sample tubing was purged with nitrogen gas for approximately 20 minutes after each soil gas sample was collected. After purging, the tube was checked with the PID and FID to ensure that it was completely evacuated of VOCs.

4.4 Soil Gas Sample Analysis

First round soil gas samples collected in 500 ml glass bulbs were analyzed on-site by SNL,NM personnel with a Viking Spectra Trak 600 GC/MS. Soil gas samples collected in SUMMA canisters were submitted to Environmental Control Technology Corporation (Encotec), Ann Arbor, MI for EPA Method TO-14 (low level) analysis. TO-14 is a mass spectrometer analysis designed to measure priority-pollutant chlorinated and aromatic VOCs in gaseous samples.

Due to an error in submitting the paperwork to Encotec, the first round SUMMA canister samples were analyzed by EPA Method TO-14 (modified high level) rather than by EPA Method TO-14 (low level). As a result, the soil gas samples analyzed at SNL,NM on the Viking GC/MS had a lower detection limit than the soil gas samples analyzed at Encotec. This is reflected in the first round analytical results (see Table 4-1).

In addition, the first round glass bulb samples submitted to SNL,NM for analysis were not analyzed for dichlorodifluoromethane, trichlorofluoromethane, or 1,1,2-trichloro-1,2,2-trifluoroethane because these compounds were not included in the Viking GC/MS calibration standards. The Viking GC/MS was only calibrated for eight target VOC compounds (acetone, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, benzene, trichloroethene, toluene, and tetrachloroethene). Because of limitations with the

Viking instrument configuration, acetone and methylene chloride could not be analyzed and were dropped from the target compound list.

Second and third round active soil gas samples were collected in SUMMA canisters only and sent off-site for analysis because the Viking GC/MS used for on-site analysis of soil gas samples was being repaired. As a result, no glass bulb analyses were conducted during the second and third rounds of sampling.

Five equipment blanks were collected during the three rounds of active soil gas sampling. Trace levels of several target analytes were detected in the equipment blanks. PCE, TCE, and benzene were detected in the first round equipment blank; methylene chloride, PCE, and TCE were detected in the two second round equipment blanks, and methylene chloride was detected in one of the two third round equipment blanks. The concentrations of contaminants detected in the equipment blanks were well below the laboratory's quantitation limit and therefore not considered to impact the quality of the data.

A duplicate soil gas sample was collected approximately once per day or once per ten samples. These duplicate samples were collected using the same procedures noted for the primary samples.

4.5 Active Soil Gas Sample Results

The results of the first, second, and third rounds of active soil gas sampling performed at the MWL are shown in Tables 4-1, 4-2, and 4-3, respectively. A total of 43 locations were sampled during the three rounds (see Figure 4-1). Each of the tables provide the coordinates for each sample collected, the sample number, the sample depth, and the concentrations of VOCs detected. Eight different VOCs were detected during the three rounds of sampling. A discussion of the distribution of VOCs in soil gas at 10 feet and 30 feet bgs is given below.

4.5.1 VOC Distribution in Soil Gas at 10 Feet

The concentrations of VOCs measured in soil gas at 10 feet bgs are shown in Figures 4-3 through 4-8. First round samples were not analyzed for dichlorodifluoromethane; trichlorofluoromethane; or 1,1,2-trichloro-1,2,2-trifluoroethane as discussed in Section 4.4. The results of three rounds of sampling at the MWL show dichlorodifluoromethane; trichlorofluoromethane; 1,1,2-trichloro-1,2,2-trifluoroethane; TCE; 1,1,1-TCA; and PCE to be present in soil gas at 10 feet bgs.

Dichlorodifluoromethane was detected at 6 sample locations within the fenced perimeter of the northern unclassified area (Figure 4-3). Concentrations of dichlorodifluoromethane

Table 4-1. First Round Active Soil Gas Sample Results (ppbv)[a], Mixed Waste Landfill
June 20 through June 22, 1994

Sample Location X Coordinate[b] (feet)	Sample Location Y Coordinate[c] (feet)	Sample Point	Depth (fbgs)[d]	dichloro-difluoro-methane[e]	tetrachloro-ethane (PCE)[e]	1,1,1-trichloro-ethane (1,1,1-TCA)[e]	trichloro-ethene (TCE)[e]	trichlorofluoro-methane[e]	1,1,2-trichloro-1,2,2-trifluoro-ethane[e]
-10	0	1	10	NA	251 E	30	131	NA	NA
-10	-50	2	10	NA	521 E	23	210	NA	NA
-10	-100	3	10	NA	1080 E	124	310 E	NA	NA
-10	-150	4	10	NA	627 E	260 E	279 E	NA	NA
-10	-175	5	10	NA	339 E	72	185	NA	NA
-10	-200	6	10	NA	186	58	114	NA	NA
50	10	7	10	NA	247 E	U	124	NA	NA
100	10	8	10	NA	205	12 J	123	NA	NA
150	10	9	13	NA	279 E	52	210	NA	NA
200	10	10	10	NA	130	19 J	126	NA	NA
250	10	11	10	NA	87	U	86	NA	NA
300	10	12	10	NA	45	11 J	53	NA	NA
310	-50	13	10	NA	30	13 J	72	NA	NA
310	-100	14	10	NA	48	16 J	113	NA	NA
310	-150	15	10	NA	33	9 J	93	NA	NA
310	-200	16	10	NA	34	24	84	NA	NA
310	-225	17	10	NA	32	17 J	76	NA	NA
250	-225	18	10	NA	56	51	435 E	NA	NA
207	-225	19	10	NA	69	188	220	NA	NA

[a]ppbv = parts per billion by volume

[b]east: positive; west: negative

[c]north: positive; south: negative

[d]fbgs = feet below ground surface

[e]Soil gas samples collected in 500 ml glass bulbs and analyzed with the GC/MS at TA-3, Bldg. 6540 by SNL,NM personnel

NA = not analyzed

E = estimated concentration greater than the upper limit of quantitation (ULOQ)

J = estimated concentration less than the lower limit of quantitation (reported down to 1/10th the LLOQ)

U = below reported quantitation level

Table 4-1. First Round Active Soil Gas Sample Results (ppbv)[a], Mixed Waste Landfill June 20 through June 22, 1994 (continued)

Sample Location X Coordinate[b] (feet)	Sample Location Y Coordinate[c] (feet)	Sample Point	Depth (fbgs)[d]	dichloro-difluoro-methane[e]	tetrachloro-ethane (PCE)[e]	1,1,1-trichloro-ethane (1,1,1-TCA)[e]	trichloro-ethene (TCE)[e]	trichlorofluoro-methane[e]	1,1,2-trichloro-1,2,2-trifluoro-ethane[e]
-10	0	1	30	NA	749 E	78	443 E	NA	NA
-10	-50	2	30	NA	958 E	69	465 E	NA	NA
-10	-100	3	30	NA	1666 E	175	682 E	NA	NA
-10	-150	4	30	NA	1479 E	337 E	776 E	NA	NA
-10	-175	5	26	NA	580 E	150	406 E	NA	NA
-10	-200	6	26	NA	464 E	67	334 E	NA	NA
50	10	7	30	NA	748 E	53	318 E	NA	NA
100	10	8	30	NA	742 E	87	524 E	NA	NA
150	10	9	30	NA	429 E	58	376 E	NA	NA
150	10	9d	30d	NA	461 E	95	373 E	NA	NA
200	10	10	30	NA	302 E	40	338 E	NA	NA
250	10	11	30	NA	154	86	233 E	NA	NA
300	10	12	30	NA	85	21 J	163	NA	NA
310	-50	13	27	NA	67	36	216	NA	NA
310	-100	14	28	NA	85	32	349 E	NA	NA
310	-150	15	30	NA	77	27	334 E	NA	NA
310	-200	16	28	NA	63	21 J	216	NA	NA
310	-225	17	30	NA	74	48	298 E	NA	NA
250	-225	18	30	NA	135	101	683 E	NA	NA
207	-225	19	30	NA	193	316 E	653 E	NA	NA

[a]ppbv = parts per billion by volume

[b]east: positive; west: negative

[c]north: positive; south: negative

[d]fbgs = feet below ground surface

[e]Soil gas samples collected in 500 ml glass bulbs and analyzed with the GC/MS at TA-3, Bldg. 6540 by SNL,NM personnel

NA = not analyzed

E = estimated concentration greater than the upper limit of quantitation (ULOQ)

J = estimated concentration less than the lower limit of quantitation (reported down to 1/10th the LLOQ)

d = duplicate sample

Table 4-1. First Round Active Soil Gas Sample Results (ppbv)[a], Mixed Waste Landfill June 20 through June 22, 1994 (concluded)

Sample Location X Coordinate[b] (feet)	Sample Location Y Coordinate[c] (feet)	Sample Point	Depth (fbgs)[d]	dichloro-difluoro-methane[e]	tetrachloro-ethane (PCE)[e]	1,1,1-trichloro-ethane (1,1,1-TCA)[e]	trichloro-ethene (TCE)[e]	trichlorofluoro-methane[e]	1,1,2-trichloro-1,2,2-trifluoro-ethane[e]
-10	0	1	30	110	450	U	230	U	190
-10	-50	2	30	440	1200	U	450	U	280
-10	-100	3	30	1300	1700	150	530	U	280
-10	-150	4	30	2300	1300	170	490	U	250
-10	-175	5	26	640	240	U	120	U	U
-10	-200	6	26	1200	670	U	330	U	220
50	10	7	30	160	1000	U	460	U	310
100	10	8	30	120	800	U	400	U	290
150	10	9	30	U	480	U	350	U	310
150	10	9d	30d	100	450	U	320	U	270
200	10	10	30	U	280	U	250	U	280
250	10	11	30	U	150	U	160	U	180
300	10	12	30	U	U	U	120	U	140
310	-50	13	27	U	U	U	140	U	U
310	-100	14	28	U	U	U	240	U	130
310	-150	15	30	U	U	U	250	160	130
310	-200	16	28	U	U	U	210	U	100
300	-225	17	30	U	U	U	230	U	100
250	-225	18	30	120	150	U	630	270	140
207	-225	19	30	280	260	320	630	740	170

[a]ppbv = parts per billion by volume

[b]east: positive; west: negative

[c]north: positive; south: negative

[d]fbgs = feet below ground surface

[e]Soil gas samples collected in 6-liter SUMMA canisters and analyzed by EPA Method TO-14 (modified high level) at Encotec, Ann Arbor, Michigan

U = below reported quantitation level

d = duplicate sample

Table 4-2. Second Round Active Soil Gas Sample Results (ppbv)[a], Mixed Waste Landfill August 15 and 16, 1994

Sample Location X Coordinate[b] (feet)	Sample Location Y Coordinate[c] (feet)	Sample Point	Depth (fbgs)[d]	dichloro-difluoro-methane[e]	tetrachloro-ethane (PCE)[e]	1,1,1-trichloro-ethane (1,1,1-TCA)[e]	trichloro-ethene (TCE)[e]	trichlorofluoro-methane[e]	1,1,2-trichloro-1,2,2-trifluoro-ethane[e]	methylene chloride[e]
-60	-85	1	10	U	110	U	U	U	U	U
-60	-125	2	10	U	160	U	U	U	U	U
-60	-175	3	10	U	77	50	51	U	20	100
-60	-175	3d	10d	U	91	U	58	U	30	U
-10	-250	4	10	U	62	10	39	12	35	U
125	-50	5	10	U	240	U	100	U	U	U
125	-100	6	10	170	240	U	U	U	U	U
125	-150	7	10	400	310	U	100	U	U	U
125	-200	8	10	320	200	U	110	U	U	U
75	-200	9	10	1800S	380	U	180	U	100	U
75	-150	10	10	29000E	1700	U	U	U	U	U
75	-100	11	10	2000	5200S	280	540	U	U	U
75	-50	12	10	U	1700	U	290	U	U	U

[a]ppbv = parts per billion by volume

[b]east: positive; west: negative

[c]north: positive; south: negative

[d]fbgs = feet below ground surface

[e]Soil gas samples were collected in 6-liter SUMMA canisters and analyzed by EPA Method TO-14 (low level) at Encotec, Ann Arbor, MI

S = results due to (secondary) dilution

E = estimated value (concentration was too large to be accurately diluted within the linear range of the calibration curve)

U = below reported quantitation level

d = duplicate sample

Table 4-2. Second Round Active Soil Gas Sample Results (ppbv)[a], Mixed Waste Landfill August 15 and 16, 1994 (concluded)

Sample Location X Coordinate[b] (feet)	Sample Location Y Coordinate[c] (feet)	Sample Point	Depth (fbgs)[d]	dichloro-difluoro-methane[e]	tetrachloro-ethane (PCE)[e]	1,1,1-trichloro-ethane (1,1,1-TCA)[e]	trichloro-ethene (TCE)[e]	trichlorofluoro-methane[e]	1,1,2-trichloro-1,2,2-trifluoro-ethane[e]	methylene chloride[e]
-60	-85	1	30	170	450	U	230	U	160	U
-60	-125	2	30	170	360	U	190	U	110	U
-60	-175	3	28.5	260	280	U	210	U	130	U
-10	-250	4	30	360	270	U	230	U	150	U
125	-50	5	30	170	520	U	270	U	170	U
125	-100	6	30	550	720	U	280	U	140	U
125	-150	7	30	1400S	1100	200	540	140	330	U
125	-200	8	30	1200	790	130	520	300	270	U
75	-200	9	25	3200S	690	150	370	U	220	U
75	-150	10	30	25000E	2700	U	U	U	U	U
75	-150	10d	30d	18000S	2300	750	600	U	320	U
75	-100	11	27	3600	5900	U	U	U	U	U
75	-50	12	30	600	1600	U	570	240	U	U

[a]ppbv = parts per billion by volume

[b]east: positive; west: negative

[c]north: positive; south: negative

[d]fbgs = feet below ground surface

[e]Soil gas samples were collected in 6-liter SUMMA canisters and analyzed by EPA Method TO-14 (low level) at Encotec, Ann Arbor, MI

S = results due to (secondary) dilution

E = estimated value (concentration was too large to be accurately diluted within the linear range of the calibration curve)

U = below reported quantitation level

d = duplicate sample

Table 4-3. Third Round Active Soil Gas Sample Results (ppbv)[a], Mixed Waste Landfill October 17 through October 21, 1994

Sample Location X Coordinate[b] (feet)	Sample Location Y Coordinate[c] (feet)	Sample Point	Depth (fbgs)[d]	dichloro-difluoro-methane	tetrachloro-ethane (PCE)[e]	1,1,1-trichloro-ethane (1,1,1-TCA)[e]	trichloro-ethene (TCE)[e]	trichlorofluoro-methane[e]	1,1,2-trichloro-1,2,2-trifluoro-ethane[e]	methylene chloride[e]	chloroform[e]
-10	-300	1	10	U	130E	29	140E	27	U	U	U
-10	-350	2	10	U	44	14	36	17	U	U	U
-10	-400	3	10	U	U	U	U	30	U	U	U
0	-440	4	10	U	U	U	13	17	44	U	U
50	-440	5	10	U	26	15	35	29	120	U	U
100	-440	6	10	U	19	18	42	41	19	14	U
150	-440	7	10	U	23	16	43	29	20	U	U
200	-440	8	10	U	28	15	49	U	U	U	U
210	-400	9	10	U	83	33	98	83	38	U	U
210	-350	10	10	U	260E	62	120	37	U	U	U
225	-300	11	10	U	U	U	120	190	U	U	U
225	-250	12	10	U	76	60	230E	110	U	U	U

[a]ppbv = parts per billion by volume

[b]east: positive; west: negative

[c]north: positive; south: negative

[d]fbgs = feet below ground surface

[e]Soil gas samples were collected in 6-liter SUMMA canisters and analyzed by EPA Method TO-14 (low level) at Encotec, Ann Arbor, MI

E = estimated value (concentration was too large to be accurately diluted within the the linear range of the calibration curve)

U = below reported quantitation level

Table 4-3. Third Round Active Soil Gas Sample Results (ppbv)[a], Mixed Waste Landfill October 17 through October 21, 1994 (concluded)

Sample Location X Coordinate[b] (feet)	Sample Location Y Coordinate[c] (feet)	Sample Point	Depth (fbgs)[d]	dichloro-difluoro-methane	tetrachloro-ethane (PCE)[e]	1,1,1-trichloro-ethane (1,1,1-TCA)[e]	trichloro-ethene (TCE)[e]	trichlorofluoro-methane[e]	1,1,2-trichloro-1,2,2-trifluoro-ethane[e]	methylene chloride[e]	chloroform[e]
-10	-300	1	30	U	300E	63	350E	180E	U	U	U
-10	-350	2	30	U	140E	44	220E	52	170E	U	U
-10	-400	3	30	U	45	68	77	67	260E	U	U
-10	-400	3d	30d	U	50	19	60	43	100	U	U
0	-440	4	30	U	19	34	38	16	U	U	U
50	-440	5	30	U	47	26	99	50	U	U	U
100	-440	6	30	U	50	36	130	U	U	U	U
150	-440	7	30	U	68	41	160	80	43	U	U
200	-440	8	30	U	77	41	210E	55	25	U	U
210	-400	9	30	U	120	65	250E	120	U	U	U
210	-350	10	30	U	280E	77	250E	230E	78	U	14
225	-300	11	30	U	140	77	270	610E	130	U	U
225	-250	12	30	U	140	U	390	370	130	U	U
225	-250	12d	30d	100	50	U	420	380	130	U	U

[a]ppbv = parts per billion by volume

[b]east: positive; west: negative

[c]north: positive; south: negative

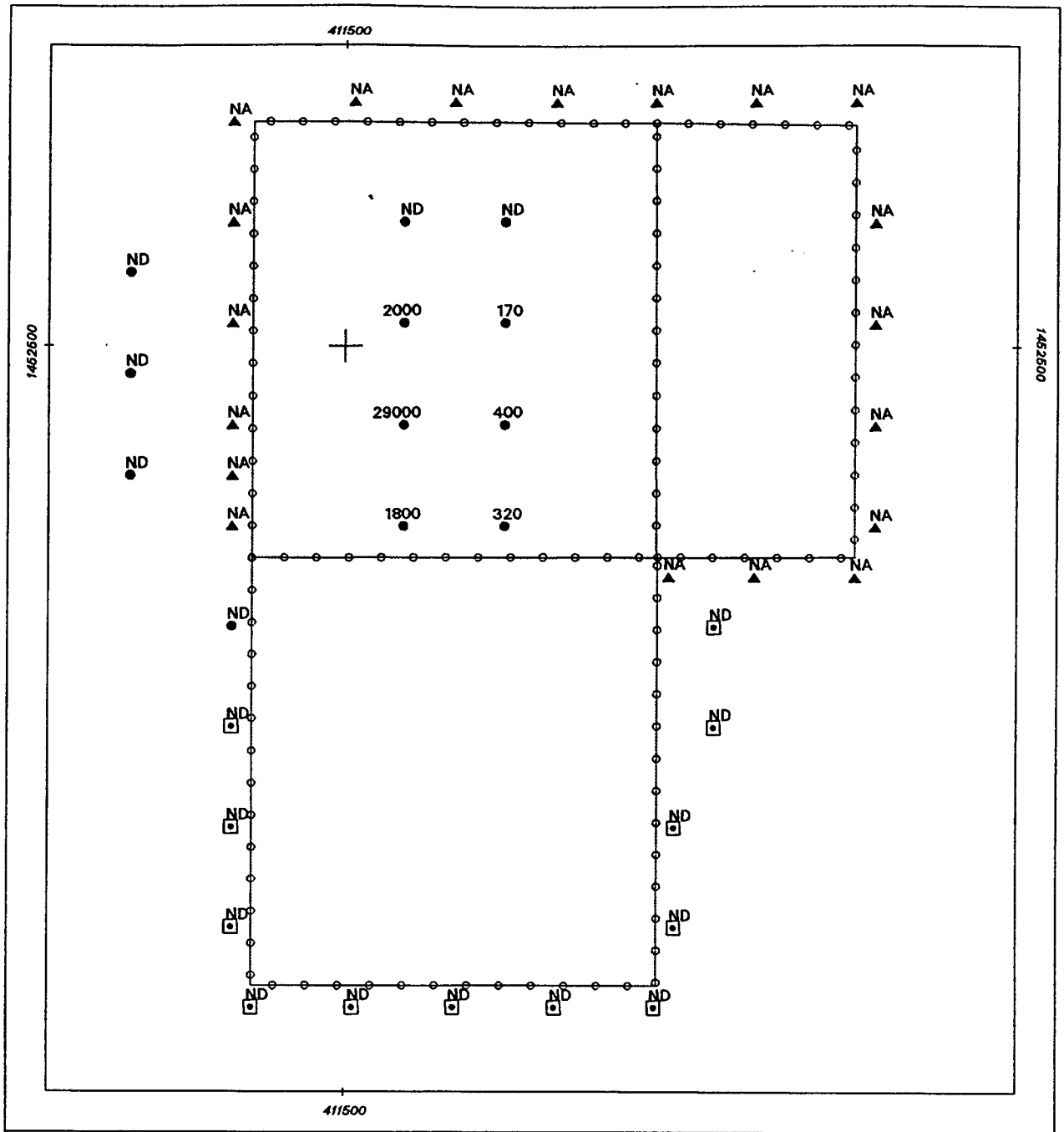
[d]fbgs = feet below ground surface

[e]Soil gas samples were collected in 6-liter SUMMA canisters and analyzed by EPA Method TO-14 (low level) at Encotec, Ann Arbor, MI

E = estimated value (concentration was too large to be accurately diluted within the the linear range of the calibration curve)

U = below reported quantitation level

d = duplicate sample



Legend

- Fences
- NA — First round sample location and concentration
- 170 — Second round sample location and concentration
- ND — Third round sample location and concentration
- ND — Not detected
- NA — Not analyzed

* Second and third round samples collected in 6-liter SUMMA canisters

Figure 4-3

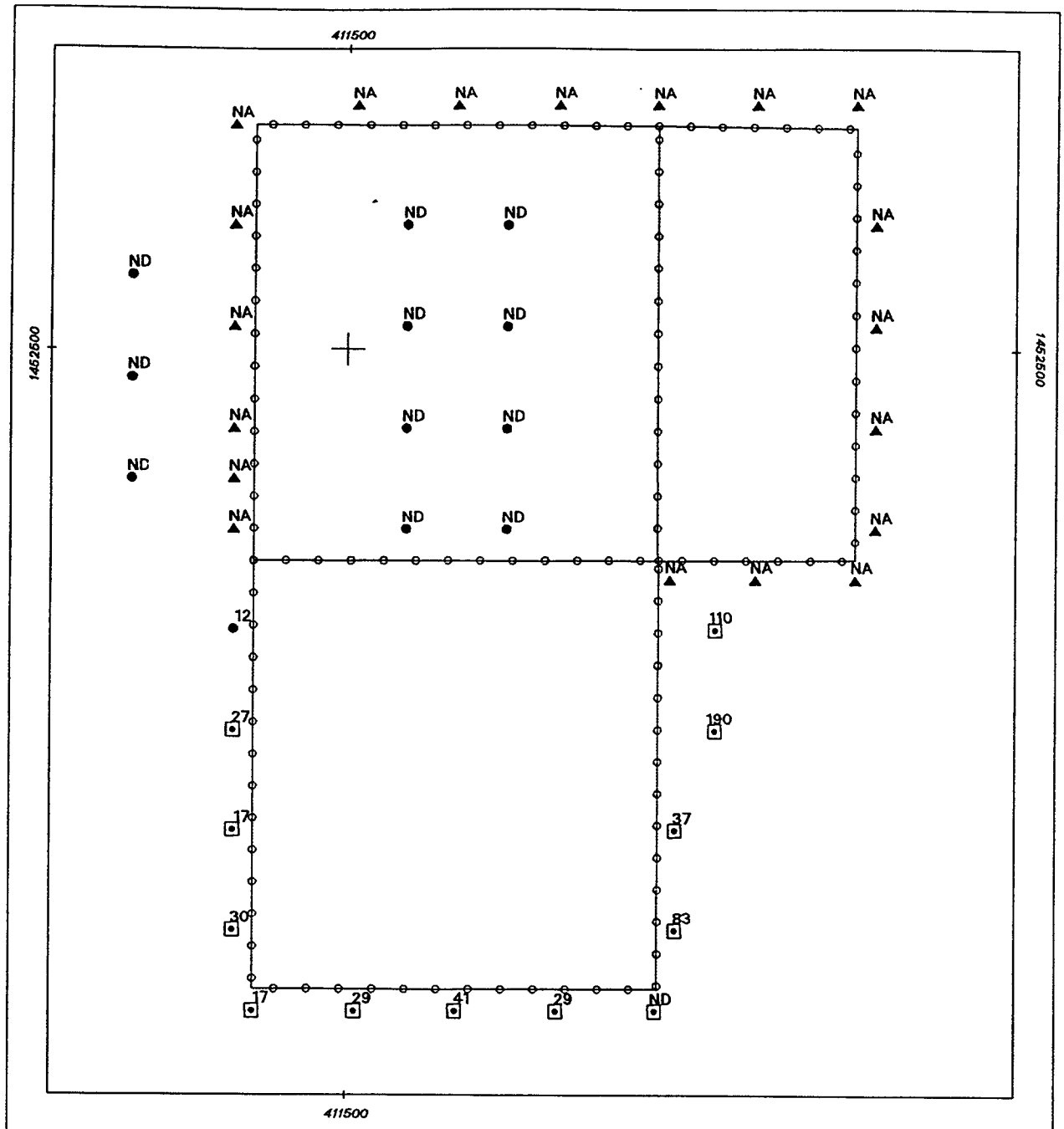
Dichlorodifluoromethane (ppbv) in Soil Gas at 10ft, Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

cpbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819w



Legend

- Fences
- NA — First round sample location and concentration
- ND — Second round sample location and concentration
- 27 — Third round sample location and concentration
- ND — Not detected
- NA — Not analyzed

* Second and third round samples collected in 6-liter SUMMA canisters

Figure 4-4

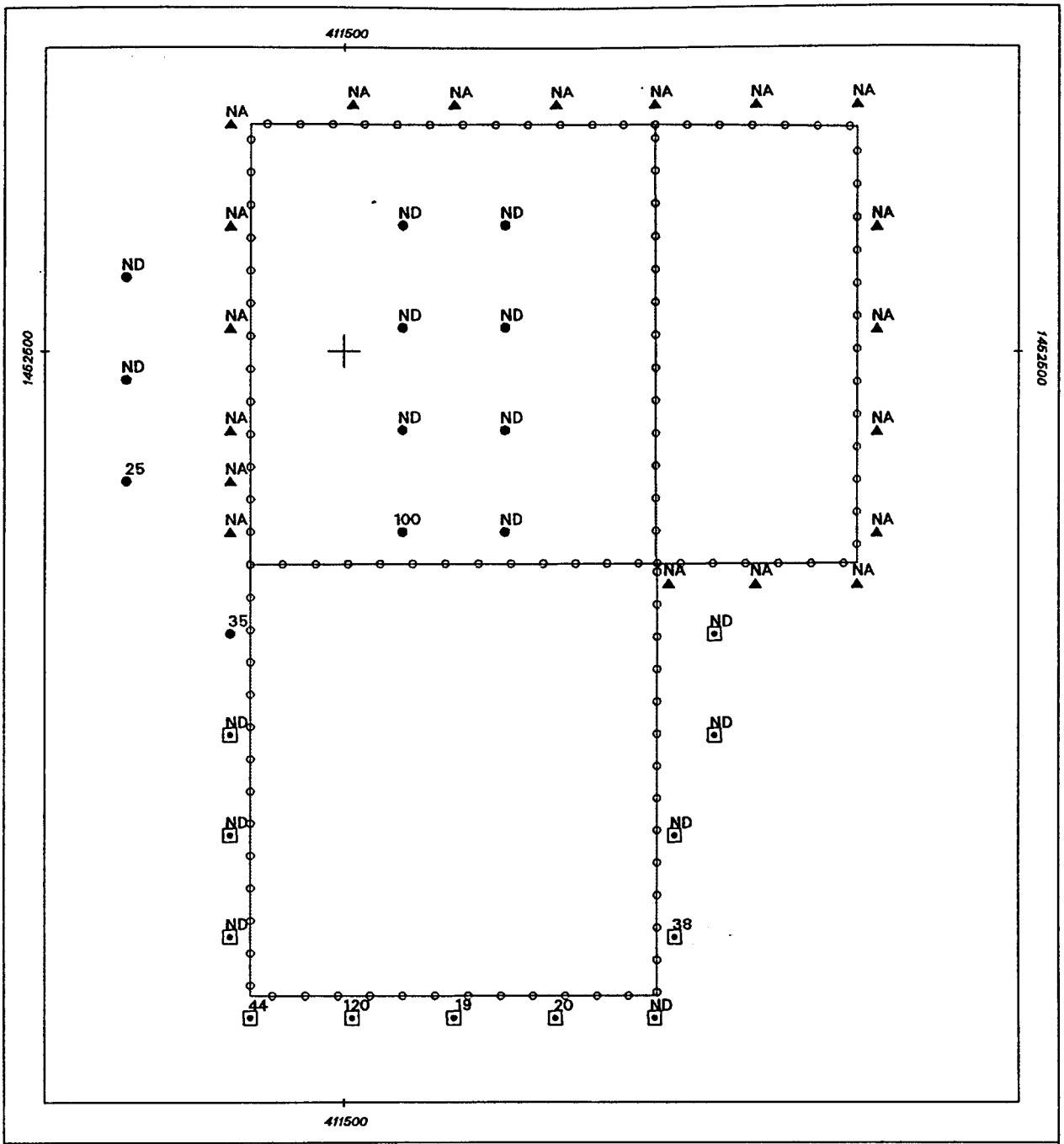
Trichlorofluoromethane (ppbv) in Soil Gas at 10ft, Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

spbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819x



Legend

- Fences
- NA — First round sample location and concentration
- 100 — Second round sample location and concentration
- 44 — Third round sample location and concentration
- ND — Not detected
- NA — Not analyzed

* Second and third round samples collected in 6-liter SUMMA canisters

Figure 4-5

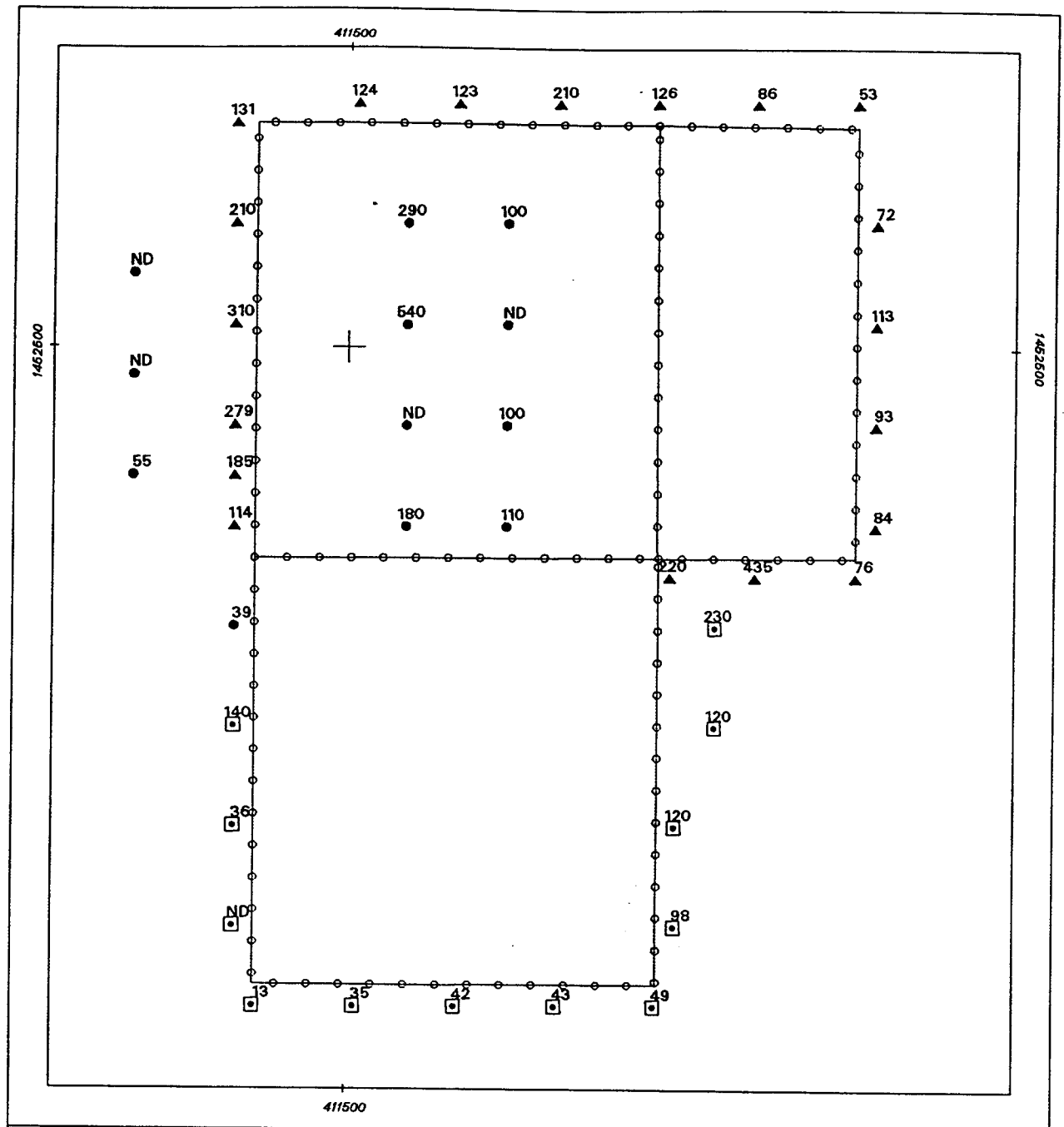
1,1,2-trichloro-1,2,2-trifluoroethane (ppbv) in Soil Gas at 10ft, Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

spbreye SNL GIS ORG. 7512 06/07/95 MAPID=950819y



Legend

- Fences
- ▲131 — First round sample location and concentration
- ●100 — Second round sample location and concentration
- ⊡36 — Third round sample location and concentration
- ND — Not detected
- NA — Not analyzed

* First round samples collected in 500 ml glass bulbs

* Second and third round samples collected in 6-liter SUMMA canisters

Figure 4-6

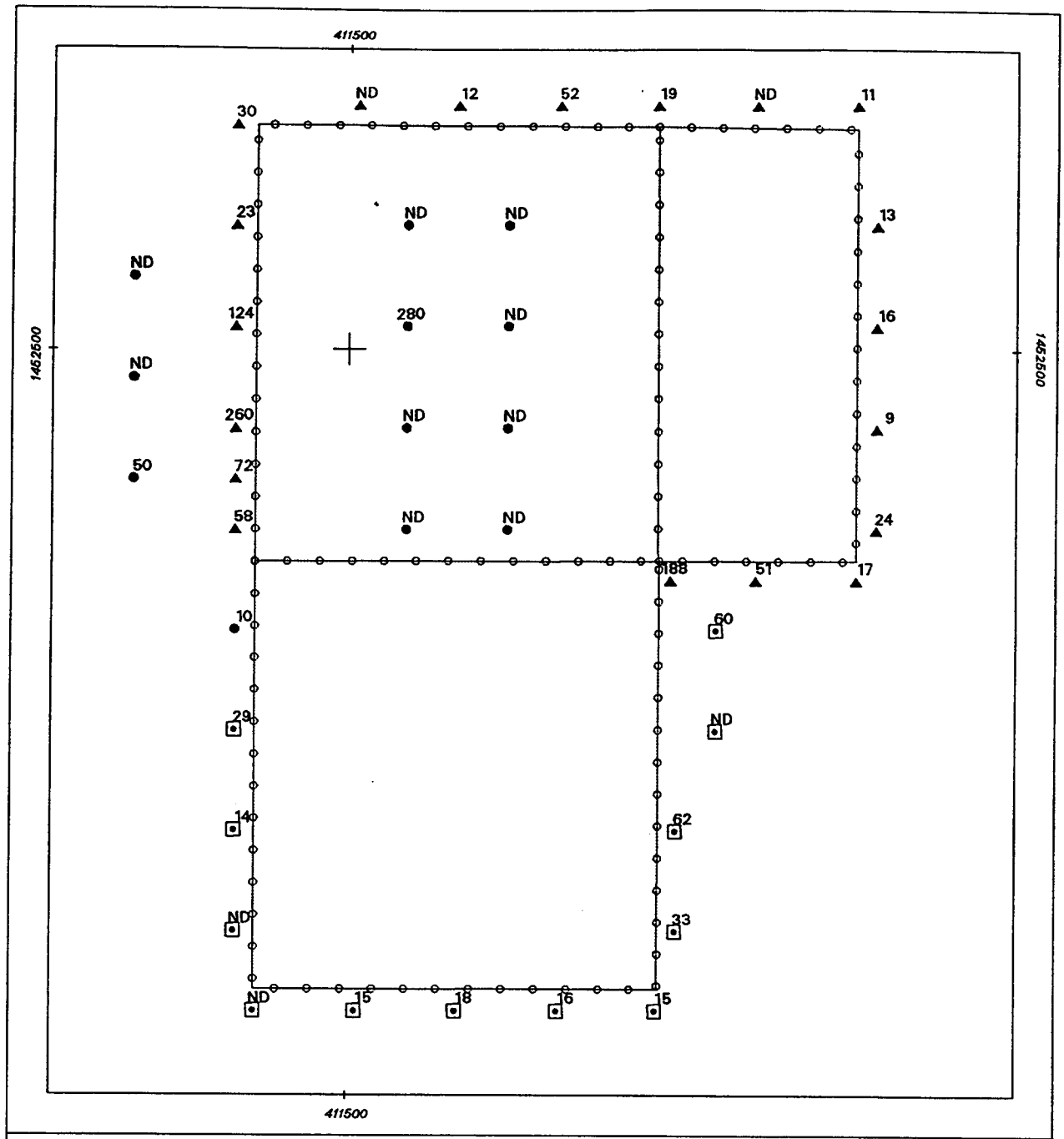
TCE (ppbv) in Soil Gas at 10ft, Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

spbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819z



Legend

- Fences
- ▲ 124 — First round sample location and concentration
- ● 280 — Second round sample location and concentration
- ⊡ 18 — Third round sample location and concentration
- ND — Not detected

* First round samples collected in 500 ml glass bulbs
* Second and third round samples collected in 6-liter SUMMA canisters

Figure 4-7

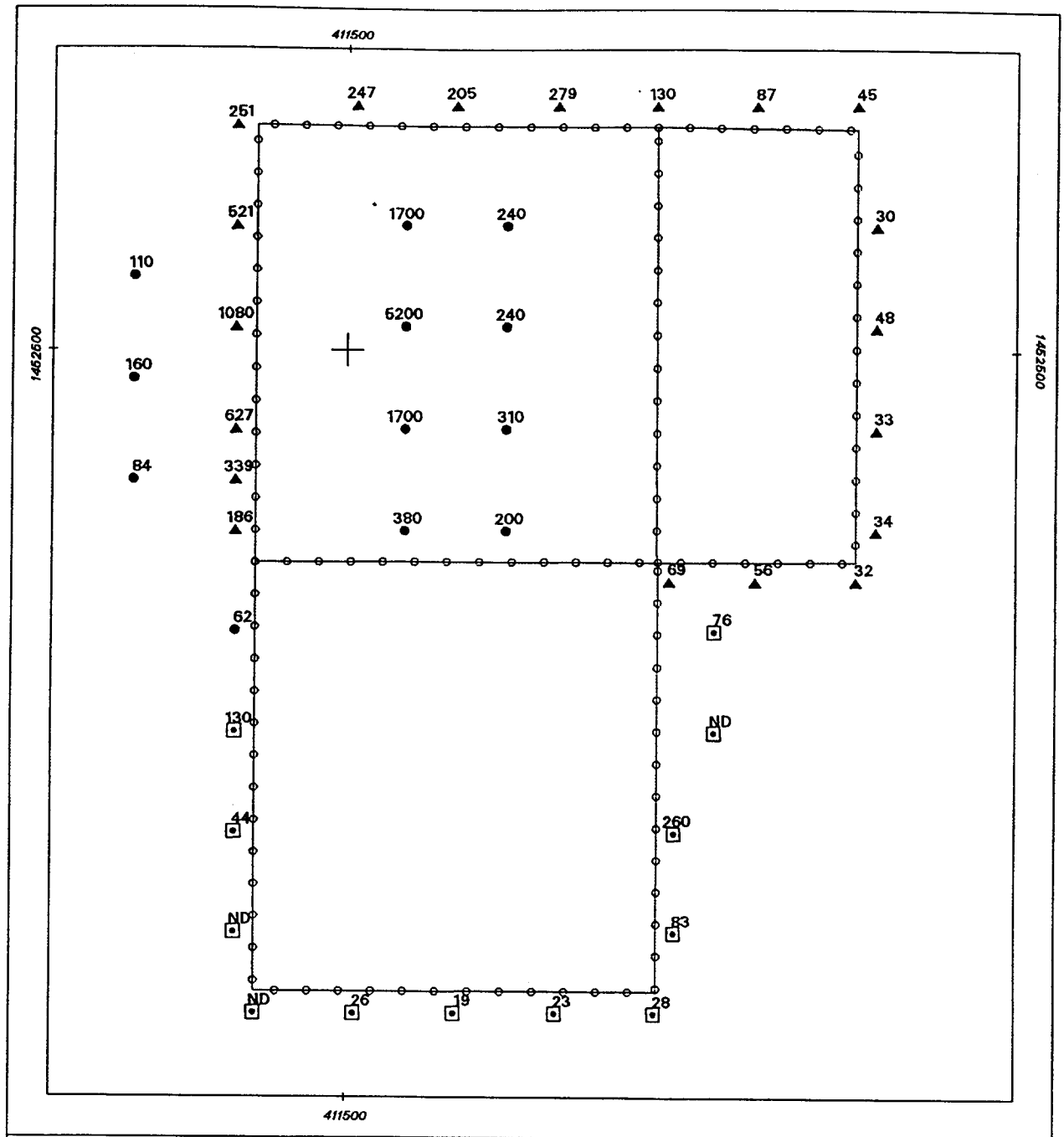
1,1,1-TCA (ppbv) in Soil Gas at 10ft, Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

spbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819aa



Legend

- Fences
- ▲247 — First round sample location and concentration
- ●84 — Second round sample location and concentration
- ⊡62 — Third round sample location and concentration
- ND — Not detected

* First round samples collected in 500 ml glass bulbs
* Second and third round samples collected in 6-liter SUMMA canisters

Figure 4-8

PCE (ppbv) in Soil Gas at 10ft, Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

epbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819bb

ranged from 170 parts per billion by volume (ppbv) to 29,000 ppbv at second round sample 10, the highest VOC concentration reported at 10 feet bgs in the three rounds of active soil gas sampling. Sample 10 was located between Trenches B and C, and was in close proximity to passive soil gas sample point 35 (see Figures 1-3 and 3-2). The highest overall flux rates of PCE and 1,1,1-TCA reported during the passive soil gas survey occurred at sample point 35. Above-background flux rates of TCE, toluene, and 1,1-dichloroethene were also reported at sample point 35.

Trichlorofluoromethane was detected at 12 sample locations outside of the fenced perimeter of the southern unclassified area (Figure 4-4). Concentrations ranged from 12 ppbv at the northwest corner to 190 ppbv on the east side. The highest overall concentrations of trichlorofluoromethane occurred on the east side of the southern unclassified area of the landfill.

1,1,2-trichloro-1,2,2-trifluoroethane was detected at 8 sample locations at concentrations ranging from 19 ppbv to 120 ppbv (Figure 4-5). Five of the eight sample points were located along the southern fenceline of the southern unclassified area.

TCE was detected at 38 sample locations (Figure 4-6). Concentrations of TCE ranged from 13 ppbv at the southwest corner of the southern unclassified area to 540 ppbv at second round sample 11 within the fenced perimeter of the northern unclassified area. Sample 11 was located between Trenches B and C, and was in close proximity to passive soil gas sample point 14 (see Figures 1-3 and 3-2). Above-background flux rates of TCE, PCE, toluene, and dichloroethyne were also reported at sample point 14 during the passive soil gas sampling. The highest overall concentrations of TCE reported during active soil gas sampling occurred at sample locations within and along the west and north fencelines of the northern unclassified area. Elevated concentrations of TCE were also reported along the southern fenceline of the classified area.

1,1,1-TCA was detected at 29 sample locations at concentrations ranging from 9 ppbv to 280 ppbv at second round sample 11 (Figure 4-7). Sample 11 was also where the highest concentration of TCE was reported (see above). Elevated concentrations of 1,1,1-TCA were also reported along the western fenceline of the northern unclassified area and in the southwest corner of the classified area.

PCE was detected at 40 sample locations at concentrations ranging from 19 ppbv to 5200 ppbv at second round sample 11 (Figure 4-8). Sample 11 was also where the highest concentrations of TCE and 1,1,1-TCA were reported (see above). The highest concentrations of PCE occurred within the fenced perimeter of the northern unclassified area, between Trenches B and C (see Figure 1-3). Three adjacent sample locations between Trenches B and C showed concentrations of PCE ranging from 1700 ppbv to 5200 ppbv. Elevated concentrations of PCE were also reported along the west and north fencelines of the northern unclassified area.

4.5.2 VOC Distribution in Soil Gas at 30 Feet

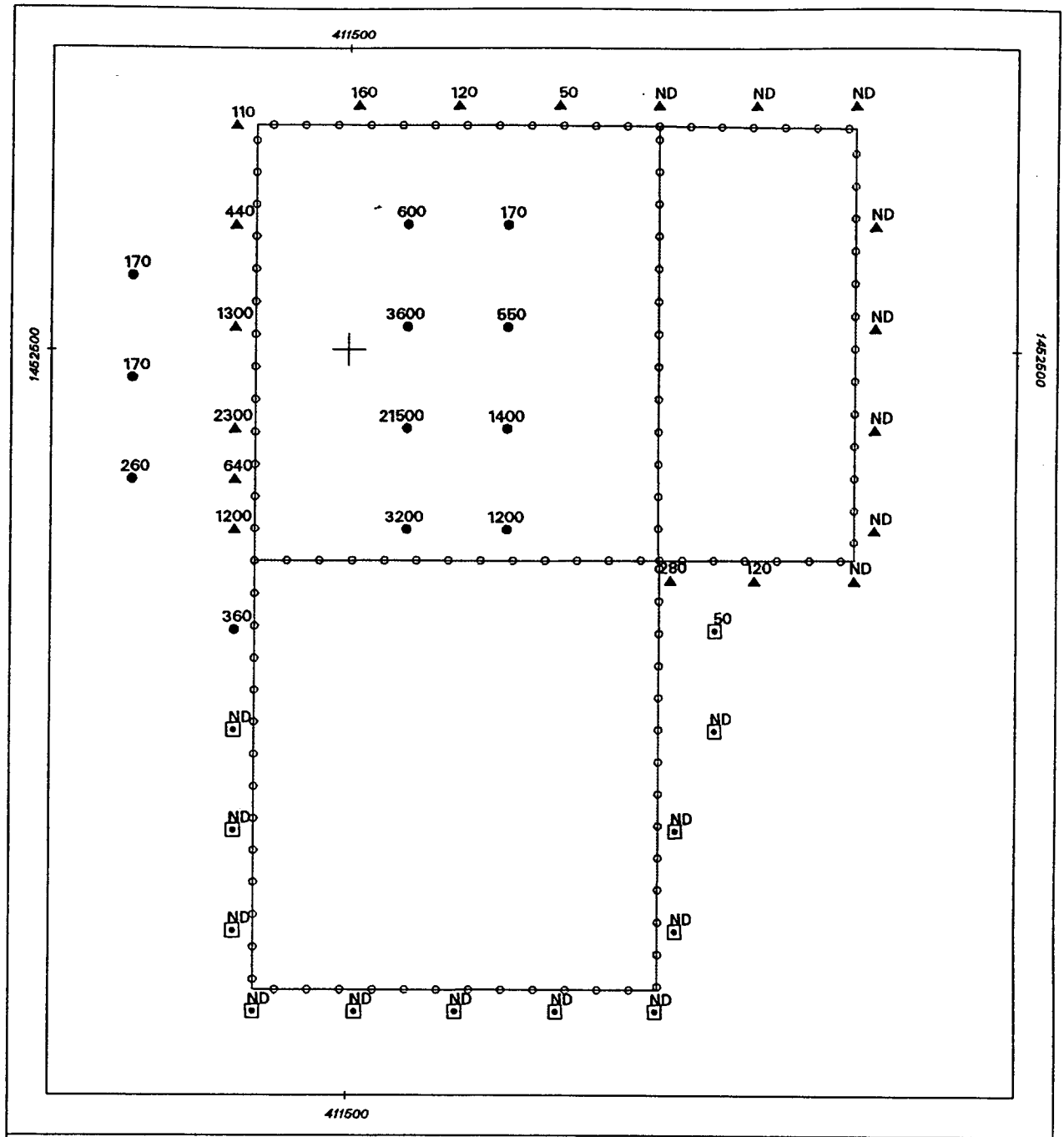
The concentrations of VOCs measured in soil gas at 30 feet bgs are shown in Figures 4-9 through 4-14. Figures 4-12, 4-13, and 4-14 show two concentrations of the particular VOC compound of interest at each of the first round sampling locations. One number shows the concentration obtained by on-site analysis of the 500 ml glass bulb sample, and the other value shows the concentration obtained by off-site analysis of the 6-liter SUMMA canister sample (see Sections 4.1 and 4.4). The results of three rounds of sampling at the MWL show dichlorodifluoromethane; trichlorofluoromethane; 1,1,2-trichloro-1,2,2-trifluoroethane; TCE; 1,1,1-TCA; and PCE to be present in soil gas at 30 feet bgs. In addition, methylene chloride was detected at two sample locations during the second and third rounds of sampling and chloroform was detected at one sample location during the third round of sampling. The results are detailed below.

Dichlorodifluoromethane was detected at 24 sample locations at concentrations ranging from 50 ppbv to 21,500 ppbv at second round sample 10, the highest VOC concentration reported at 30 feet bgs in the three rounds of active soil gas sampling (Figure 4-9). Sample 10 was located between Trenches B and C (Figure 1-3), where the highest concentration of dichlorodifluoromethane at 10 feet bgs was reported (Figure 4-3). Concentrations of dichlorodifluoromethane reported at five of the eight sample locations within the fenced perimeter of the northern unclassified area (between Trenches B and C and between Trenches C and D) ranged from 1200 ppbv to 21,500 ppbv. Elevated concentrations were also reported at sample locations along the west fenceline of the northern unclassified area. Dichlorodifluoromethane was, for the most part, not detected around the fenced perimeters of either the southern unclassified area or the classified area.

Trichlorofluoromethane was detected at 17 sample locations, mainly around the fenced perimeter of the southern unclassified area and within the fenced perimeter of the northern unclassified area (Figure 4-10). Concentrations ranged from 16 ppbv at the southwest corner of the southern unclassified area to 740 ppbv in the southwest corner of the classified area. The highest overall concentrations of trichlorofluoromethane were reported along the fenceline in the northeast corner of the southern unclassified area. Elevated concentrations were also reported at three sample locations within the fenced perimeter of the northern unclassified area.

1,1,2-trichloro-1,2,2-trifluoroethane was detected at 34 sample locations at concentrations ranging from 25 ppbv to 330 ppbv (Figure 4-11). The highest concentrations of the compound were reported at sample locations along the north and west fencelines of the northern unclassified area. Elevated concentrations of the compound were also reported in the southwest corner of the classified area, and along the western and eastern fencelines of the southern and classified areas, respectively.

TCE was detected at 42 of the 43 locations sampled (Figure 4-12). First round sample concentrations reported from glass bulb analysis ranged from 163 ppbv to 776 ppbv.



Legend

- Fences
- ▲ 110 — First round sample location and concentration
- ● 170 — Second round sample location and concentration
- ⊡ 360 — Third round sample location and concentration
- ND — Not detected

* All samples collected in 6-liter SUMMA canisters

Figure 4-9

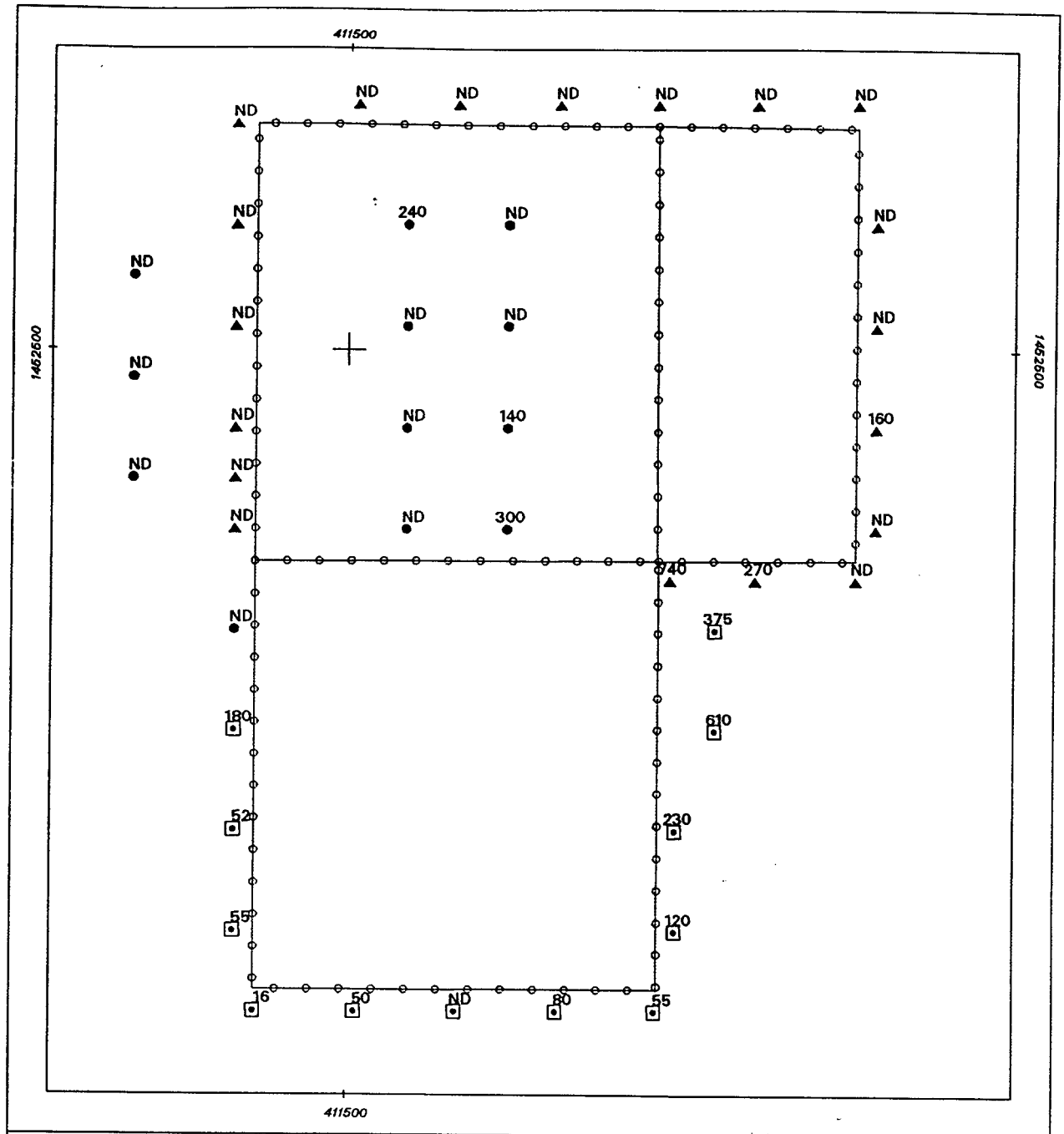
Dichlorodifluoromethane (ppbv) in Soil Gas at 30ft, Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

epbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819cc



Legend

- Fences
- ▲270 — First round sample location and concentration
- ●140 — Second round sample location and concentration
- ⊡52 — Third round sample location and concentration
- ND — Not detected

* All samples collected in 6-liter SUMMA canisters

Figure 4-10

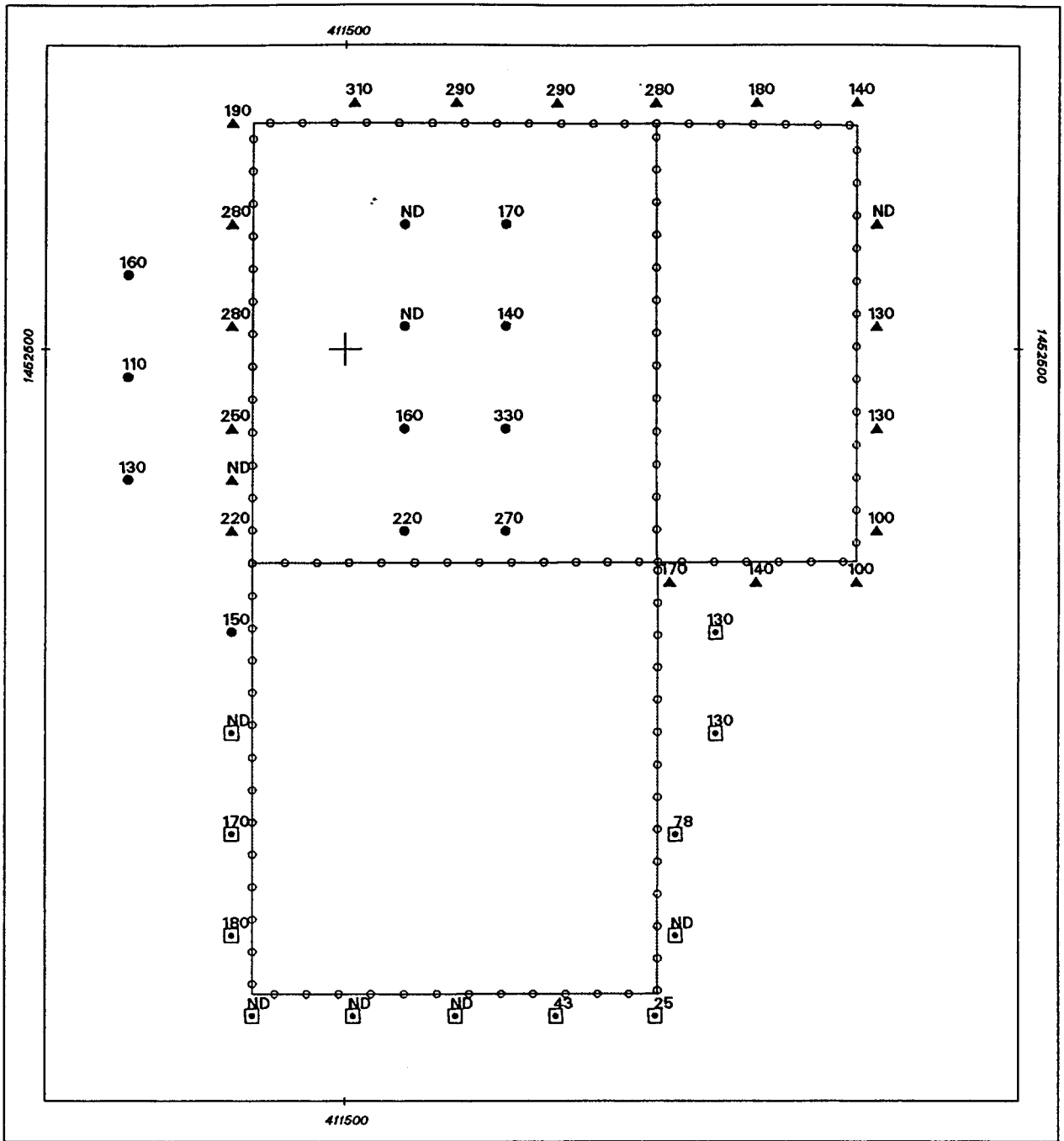
Trichlorofluoromethane (ppbv) in Soil Gas at 30ft, Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

spbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819a



Legend

- Fences
- ▲ 190 — First round sample location and concentration
- ● 140 — Second round sample location and concentration
- ⊡ 170 — Third round sample location and concentration
- ND — Not detected

* All samples collected in 6-liter SUMMA canisters

Figure 4-11

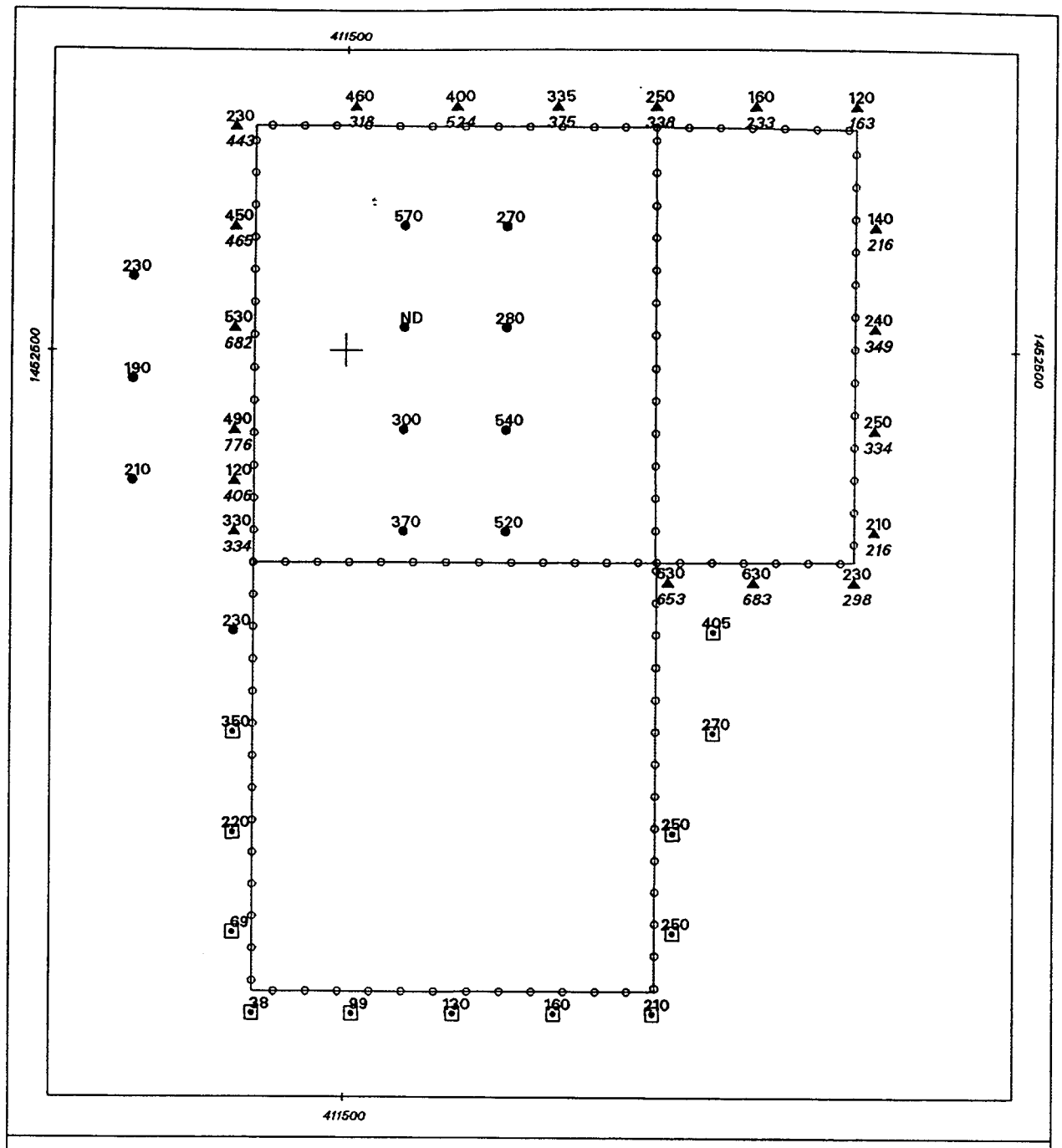
1,1,2-trichloro-1,2,2-trifluoroethane (ppbv) in Soil Gas at 30ft, Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

spbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819b



Legend

- Fences
- ▲450 / *465* — First round sample location and concentration
- ●300 — Second round sample location and concentration
- ⊡220 — Third round sample location and concentration
- ND — Not detected
- 230 — First round samples collected in 6-liter SUMMA canisters
- *443* — *First round samples collected in 500 ml glass bulbs*

* Second and third round samples collected in 6-liter SUMMA canisters

Figure 4-12

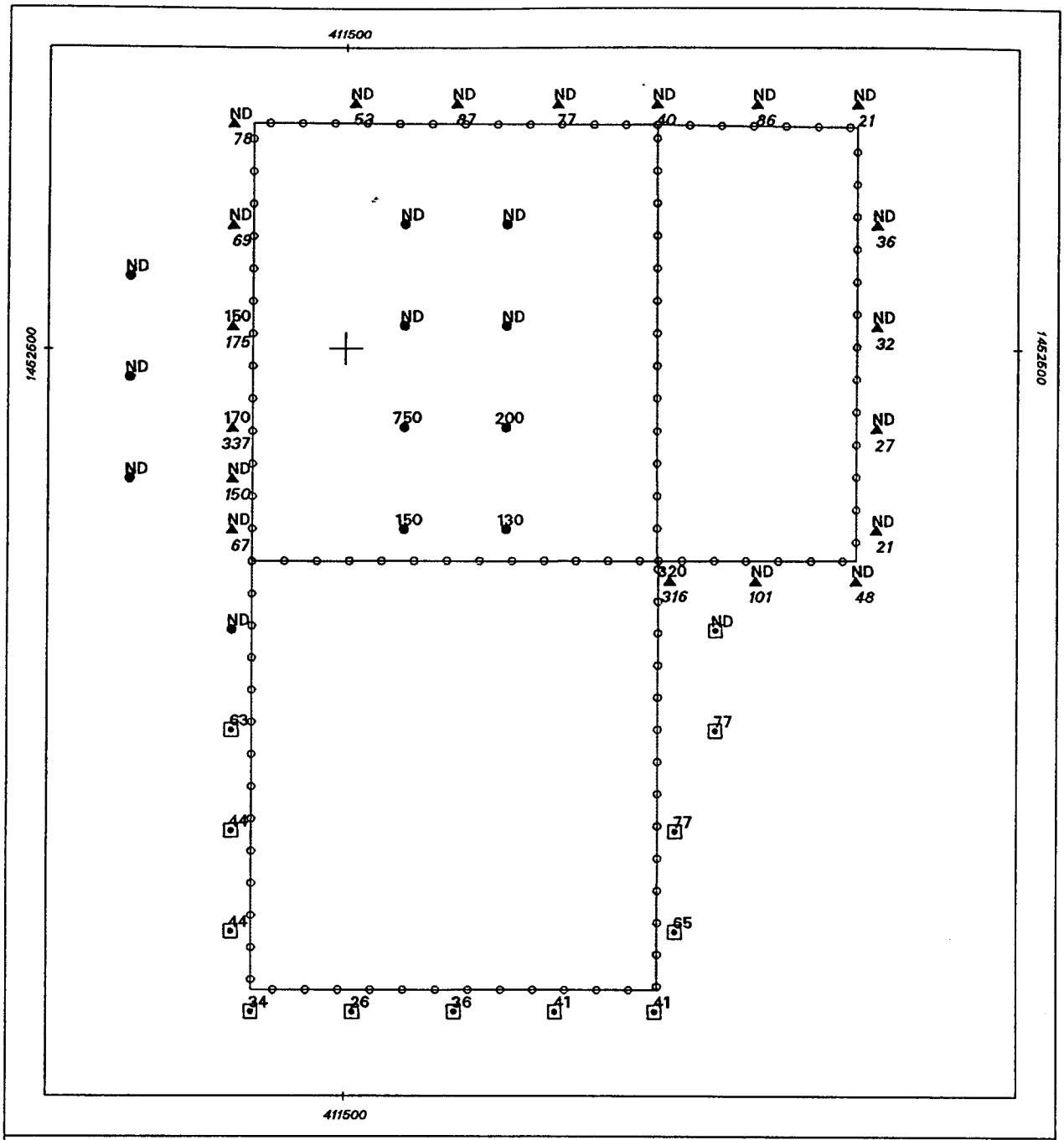
TCE (ppbv) in Soil Gas at 30ft, Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

spbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819c



Legend

- Fences
- ▲ 150 / *175* — First round sample location and concentration
- ● 760 — Second round sample location and concentration
- ⊡ 44 — Third round sample location and concentration
- ND — Not detected
- 150 — First round samples collected in 6-liter SUMMA canisters
- *175* — *First round samples collected in 500 ml glass bulbs*

* Second and third round samples collected in 6-liter SUMMA canisters

Figure 4-13

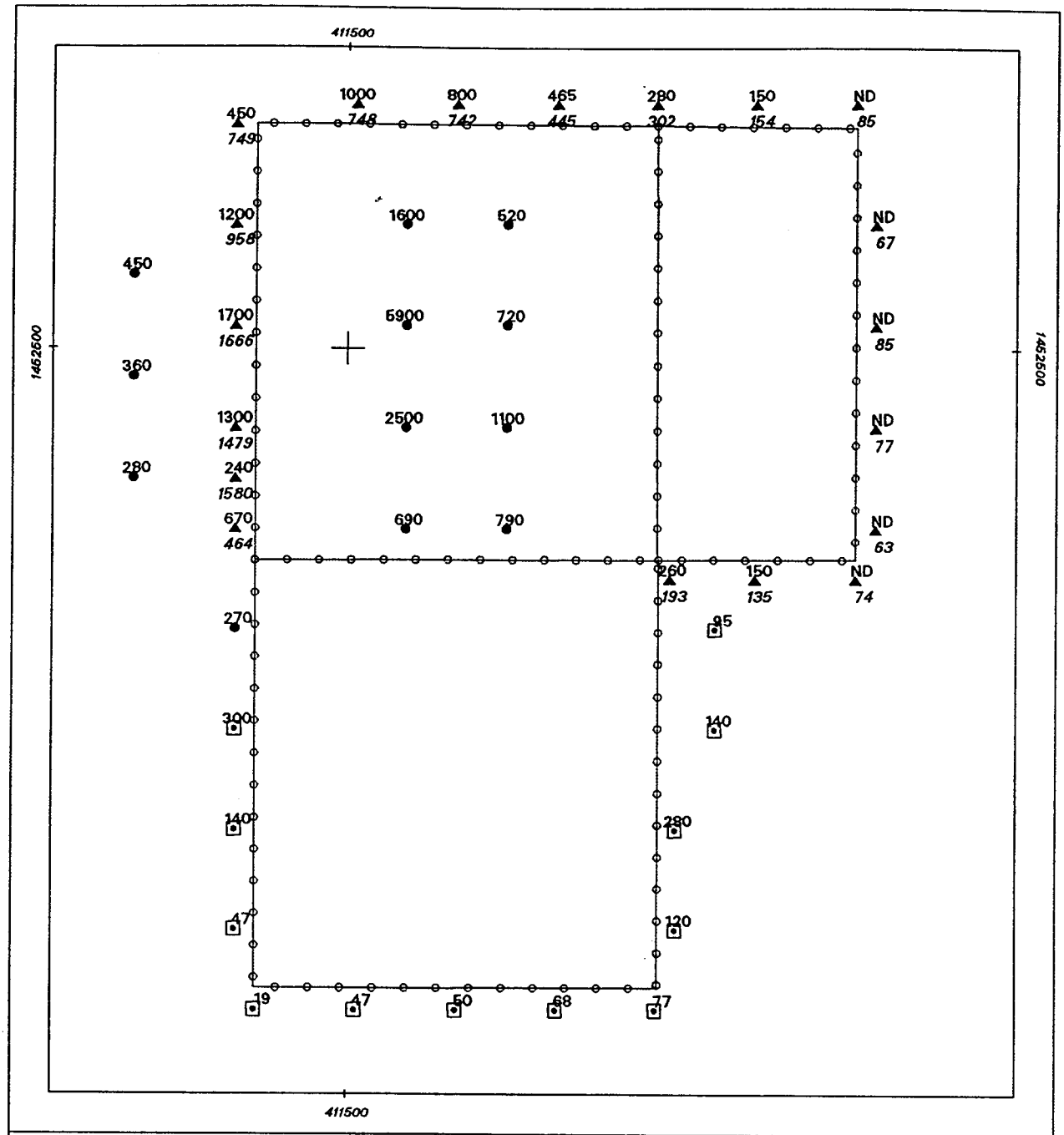
1,1,1-TCA (ppbv) in Soil Gas at 30ft, Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

spbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819d



Legend

- Fences
- ▲ 450 / *749* — First round sample location and concentration
- ● 720 — Second round sample location and concentration
- ⊡ 47 — Third round sample location and concentration
- ND — Not detected
- 450 — First round samples collected in 6-liter SUMMA canisters
- *749* — *First round samples collected in 500 ml glass bulbs*

* Second and third round samples collected in 6-liter SUMMA canisters

Figure 4-14

PCE (ppbv) in Soil Gas at 30ft, Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

epbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819e

First, second, and third round sample concentrations of TCE reported from analyses of SUMMA canisters ranged from 120 ppbv to 630 ppbv. The highest overall concentrations of TCE were reported at sample locations within the fenced perimeter and along the western fenceline of the northern unclassified area, and along the southern fenceline of the classified area.

1,1,1-TCA was detected at all of the first round sampling locations (Figure 4-13). First round sample concentrations reported from glass bulb analysis ranged from 21 ppbv to 337 ppbv. First, second, and third round sample concentrations of 1,1,1-TCA reported from analyses of SUMMA canisters ranged from 26 ppbv to 750 ppbv. The highest concentrations of 1,1,1-TCA were reported along the western fenceline and within the fenced perimeter of the northern unclassified area, and in the southwest corner of the classified area. 1,1,1-TCA was also reported around the entire perimeter of the southern unclassified area.

PCE was detected at all of the first round sampling locations (Figure 4-14). First round sample concentrations reported from glass bulb analysis ranged from 63 ppbv to 1,666 ppbv. First, second, and third round sample concentrations of PCE reported from analyses of SUMMA canisters ranged from 19 ppbv at the southwest corner of the southern unclassified area to 5,900 ppbv in the northern unclassified area of the landfill at second round sample 11. The highest concentration of PCE (5,200 ppbv) measured at 10 feet bgs was also reported at second round sample 11 (Figure 4-8). The highest overall concentrations of PCE were reported within the fenced perimeter of the northern unclassified area between Trenches B and C, and between Trenches C and D (see Figure 1-3). Elevated concentrations of PCE were also reported along the northern and western fencelines of the northern unclassified area, and around the entire perimeter of the southern unclassified area.

Methylene chloride was detected at two sample locations. A concentration of 100 ppbv was reported at second round sample 3 (a duplicate sample taken at the same location showed no measurable concentration of methylene chloride), and a concentration of 14 ppbv was reported at third round sample 6. No other measurable concentrations of methylene chloride were reported during the active soil gas sampling. In addition, trace levels of methylene chloride were present in both of the equipment blanks taken during the second round of sampling, and in one of the two equipment blanks taken during the third round of sampling.

Chloroform was detected at a single sample location (third round sample 10) at a concentration of 14 ppbv. No other measurable concentrations of chloroform were reported during the active soil gas sampling.

5.0 SUMMARY

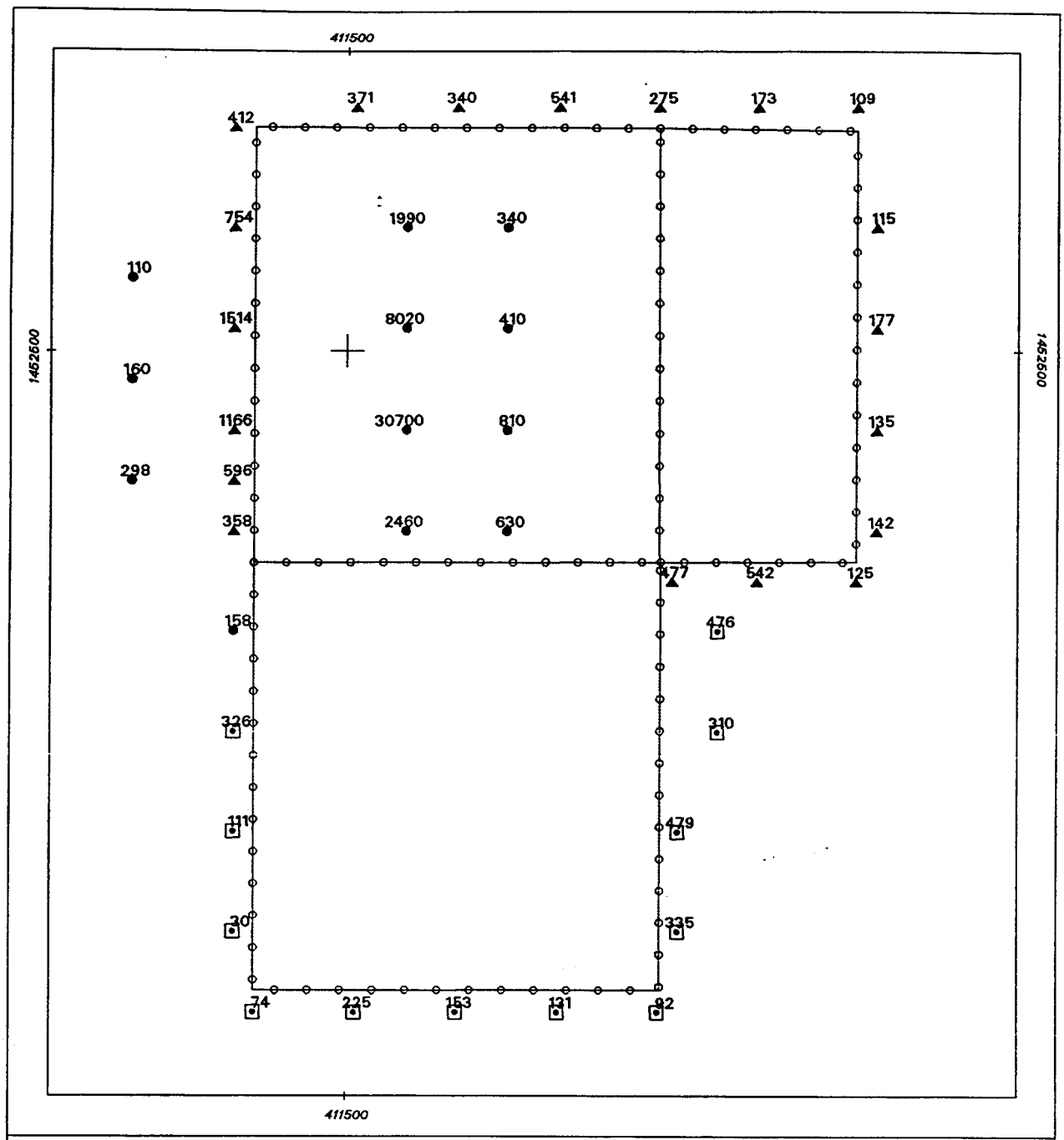
Results of the passive and active soil gas surveys conducted at the MWL clearly show that a limited number of VOCs are present at low levels in soil gas at 10 and 30 feet bgs. Seven VOCs were detected during two rounds of passive soil gas sampling. These included: PCE; TCE; 1,1,1-TCA; toluene; 1,1,2-trichlorotrifluoroethane; and acetone. Dichloroethyne was also tentatively identified during the passive soil gas sampling.

Three rounds of active soil gas sampling at 43 locations within the northern unclassified area and around the fenced perimeter of the MWL quantified levels of PCE; TCE; 1,1,1-TCA; trichlorotrifluoromethane; dichlorodifluoromethane; and 1,1,2-trichloro-1,2,2-trifluoroethane in soil gas at the MWL. Toluene; 1,1,2-trichlorotrifluoroethane; acetone; and dichloroethyne were not detected during the three rounds of active soil gas sampling.

Figures 5-1 and 5-2 present the total-VOC concentrations reported from the three rounds of active soil gas sampling at 10 and 30 feet bgs. Total-VOCs represent the sum of all VOCs detected at each sample location. Total-VOC concentrations at 10 feet bgs ranged from 30 ppbv in the southwest corner of the southern unclassified area to 30,700 ppbv in the northern unclassified area of the landfill (Figure 5-1). Total-VOC concentrations measured at 30 feet bgs ranged from 107 ppbv in the southwest corner of the southern unclassified area to 27,700 ppbv in the northern unclassified area of the landfill (Figure 5-2).

Soil gas concentrations measured at 10 and 30 feet bgs corresponded very well. Total-VOC concentrations generally increased with depth. Sample locations showing the highest concentrations of total-VOCs measured at 10 feet bgs were typically the same sample points that showed the highest concentrations at 30 feet bgs. For example, the three sample locations with the highest total-VOC concentrations at 10 feet bgs (second round samples 9, 10, and 11) were the same three sample locations showing the highest total-VOC concentrations at 30 feet bgs. There appears to be three areas where total-VOC concentrations at 10 and 30 feet bgs are higher than they are in other areas of the landfill. The highest overall concentrations of total-VOCs were reported within the fenced perimeter of the northern unclassified area between Trenches B and C and between Trenches C and D. Elevated concentrations were also reported along the west fenceline of the northern unclassified area and in the northeast corner of the southern unclassified area.

A comparison of total-VOC concentrations at the MWL with the CWL 100 ppmv plume definition level (discussed in Section 4.0) indicates that VOC concentrations at 10 and 30 feet bgs are of little significance and should be considered to be below regulatory concern. The highest total-VOC concentration reported at the MWL (reported at second round sample 10 at 10 feet bgs) was 30,700 ppbv (30.7 ppmv), nearly an order of magnitude lower than the CWL plume definition level (SNL, 1993).



Legend

- Fences
- ▲ 754 — First round sample location and concentration
- ● 810 — Second round sample location and concentration
- ⊡ 111 — Third round sample location and concentration

* First round samples collected in 500 ml glass bulbs
* Second and third round samples collected in 6-liter SUMMA canisters

Figure 5-1

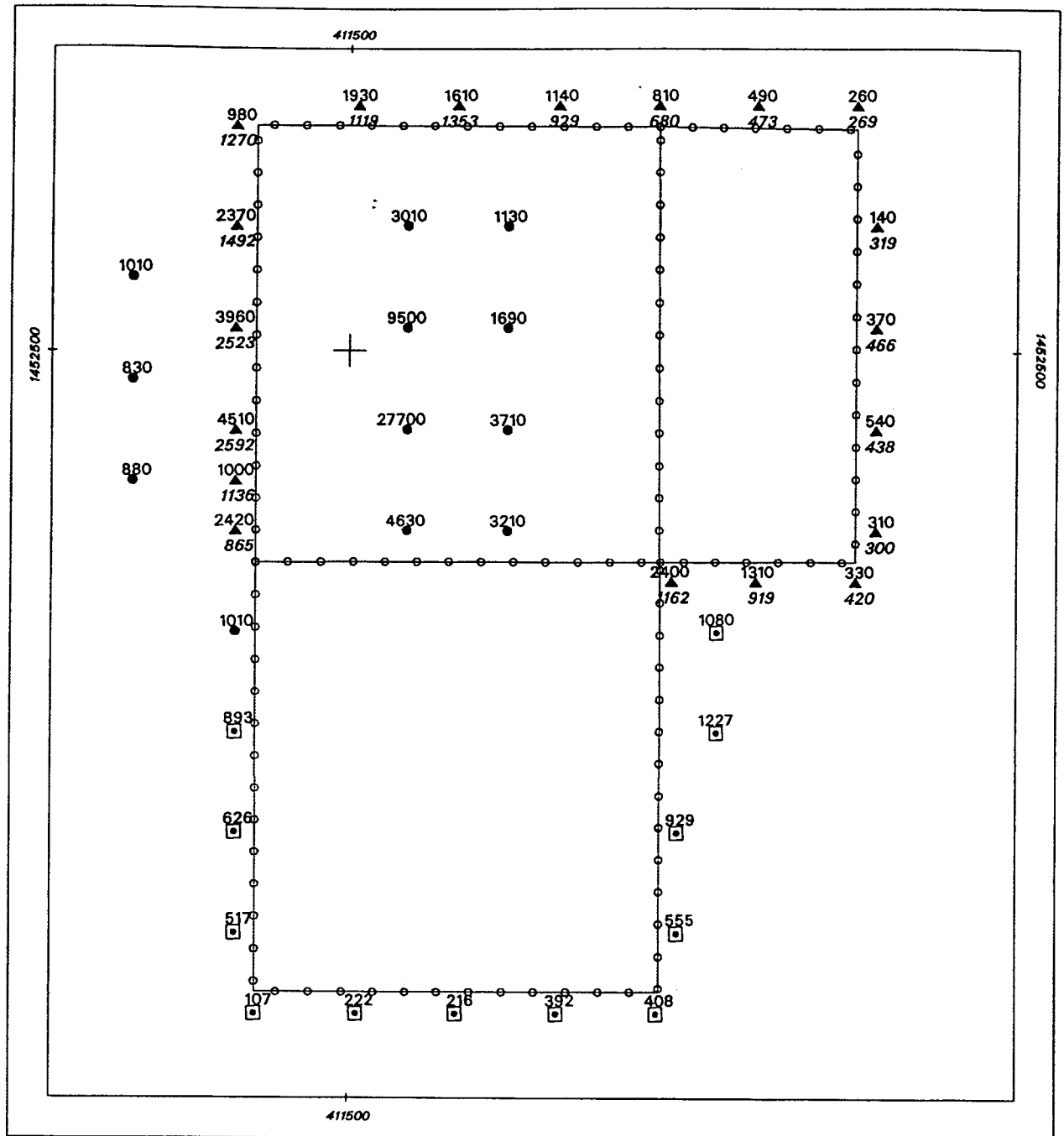
Total VOCs (ppbv) in Soil Gas at 10ft, Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

cpbreye SNL GIS ORG. 7512 04/25/95 MAPID=950819f



Legend

- Fences
- ▲ 810 / *680* — First round sample location and concentration
- ● 1130 — Second round sample location and concentration
- ⊡ 626 — Third round sample location and concentration
- 150 — First round samples collected in 6-liter SUMMA canisters
- *1270* — *First round samples collected in 500 ml glass bulbs*

* Second and third round samples collected in 6-liter SUMMA canisters

Figure 5-2

Total VOCs (ppbv) in Soil Gas at 30ft, Mixed Waste Landfill

0 40 80
Scale in Feet

0 9.6 19.2
Scale in Meters

N

sisotel SNL GIS ORG. 7612 04/25/95 MAPID=950819g

6.0 REFERENCES

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